An Annotated Bibliography on Forest-Range Ecosystems in the Pacific Northwest

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An Annotated Bibliography on Forest-Range Ecosystems in the Pacific Northwest

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September 1985

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1 INTRODUCTION

Within the last decade, increasing demands have been made on the timber, range, wildlife, and recreational resources of forests in western Canada and the United States. This situation has led to conflicts of interest among the various user groups. Major issues of contention include the effects of grass competition and livestock grazing on conifer regeneration, and the loss of potential summer range due to single-purpose logging and silvicultural practices.

Issues such as these have stimulated the need for a compilation of existing literature on the topic to help resolve differences of opinion, encourage compatability in resource use, and identify problems requiring further study. This bibliography synthesizes a large body of knowledge into a single volume, in an attempt to improve understanding of the ecology and management of forest-range.

1.1 Scope

The nucleus of the bibliography is derived from a recent literature review on forest grazing in British Columbia, published by the B.C. Ministry of Forests.[1] Geographically, the bibliography emphasizes literature originating in the Pacific Northwest, specifically Alberta, British Columbia, Idaho, Montana, Oregon, and Washington. However, literature from central and southeastern United States, Australia, and New

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[1] **L.O. Nordstrom. 1985. The ecology and management of forest-range in British Columbia: a review and analysis. B.C. Min. For., Land Manage. Rep. No. 19, 104 p.**

Zealand is incorporated where the information has general or widespread relevance and applicability.

The subject matter is largely concerned with the autecology and synecology of plants and animals in forest-range ecosystems, primarily in relation to resource management. Economic and philosophical perspectives on forest-range issues are also covered. Main topics addressed in the bibliography include:

1. the seeding of grass/legume mixtures in logged environments;
2. the silvics and regeneration of commercially valuable conifers on forest-range in the Pacific Northwest;
3. synecological interactions among introduced grasses and legumes, trees, and native vegetation;
4. impacts of livestock and wildlife on seeded and native forages, and coniferous tree seedlings;
5. effects of silvicultural treatments on forage production and utilization in late successional forest stands;
6. dietary overlap between domestic livestock and big game on forest-range;
7. principles and practices of livestock management on forest-range; and
8. the economics of tree/forage/livestock interactions.

The bibliography is current through August 1985. Most of the citations refer to published journal articles, government- and university-sponsored technical reports and research notes, theses and dissertations, and published conference proceedings. However, a few unpublished papers are also contained in the bibliography; copies of these may be obtained upon request from Research Branch, Ministry of Forests.

1.2 Format

The bibliographic entries are listed alphabetically by author, and adhere to the stylistic conventions recommended by the Research Branch, B.C. Ministry of Forests.[2] Publication data include, at a minimum, author(s), title, year of publication, journal or sponsoring agency, volume or series number, and pagination. Abbreviations are generally avoided to prevent ambiguity or difficulty in locating the documents.

All citations are accompanied by a short, descriptive annotation which indicates the main research findings, observations, opinions, recommendations, or philosophical theme of the paper. Detailed indexes facilitate retrieval of the bibliographic records by author, subject, geographical location, and plant species. The latter is particularly useful since species studied are not always specifically identified in the annotations.

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[2] G. Montgomery. 1983. Style guide for research publications. B.C. Min. For., Res. Br., Victoria, B.C. 77 p.

2 BIBLIOGRAPHY

1.

Adams, S.N. 1975. **Sheep and cattle grazing in forests: a review.** Journal of Applied Ecology 12: 143-152.

World literature on forest grazing by domestic livestock is reviewed. Author concludes that the practice must be controlled if it is to be successful. He further states that livestock will always do some damage to trees: sheep by browsing and cattle by trampling.

2.

Alexander, E.W. 1977. **Cutting methods in relation to resource use in central Rocky Mountain spruce-fir forests.** Journal of Forestry 75: 395-400.

Silvicultural systems used to regenerate Engelmann spruce and subalpine fir are described, and their impacts on timber, soil, water, wildlife, range, recreation, and aesthetic resources assessed. A useful figure, ranking the effects of different systems on forage production, is presented.

3.

Anderson, C.H. and C.R. Elliott. 1957. **Studies on the establishment of cultivated grasses and legumes on burned-over land in northern Canada.** Canadian Journal of Plant Science 37: 97-101.

The performance of nine domestic forage species seeded on burned deciduous forestland in the Peace River is evaluated. Time of seeding did not influence the establishment of grasses, but spring-seeded legumes exhibited better survival and growth than those sown in autumn.

4.

Anderson, E.W. and L.E. Brooks. 1975. **Reducing erosion hazard on a burned forest in Oregon by seeding.** Journal of Range Management 28(5): 394-398.

The revegetation of a burned ponderosa pine/Douglas-fir forest is described. Seeded grasses produced a satisfactory vegetal cover within 1 year, but broadcast seeded trees and legumes failed to establish. Native vegetation recovered very slowly.

5.

Andre, P.D. 1981. **Cattle and forests are compatible!** Beef 17(8): 40-41.

This editorial comment based is on interviews with J.D. Monfore, land use supervisor, Weyerhaeuser Ltd., and Dr. W.C. Krueger, Oregon State University. The consensus of these two individuals is that timber and livestock production can be successfully combined.

6.
Armit, D. 1966. **Silvics and silviculture of lodgepole pine in the north central interior of British Columbia.** B.C. Forest Service, Research Note No. 40. 50 p.

A review of the literature on lodgepole pine silvics and ecology is presented, and research needs are identified.

7.
Armour, C.D., S.C. Bunting and L.F. Neuenschwander. 1984. **Fire intensity effects on the understory in ponderosa pine forests.** Journal of Range Management 37: 44-49.

Changes in understory dominance structure following a burn were (1) related to the amount of duff consumed by the fire and (2) independent of fire line intensity and flame length. Graminoid cover was lowest on high fire line intensity sites, but there were no significant differences in cover of shrubs or forbs among intensity treatments.

8.
Arnold, J.F. 1950. **Changes in ponderosa pine bunchgrass ranges in northern Arizona resulting from pine regeneration and grazing.** Journal of Forestry 48: 118-126.

Ponderosa pine seedlings gained dominance over grass cover within 5 years, largely by surmounting herbaceous root competition for soil moisture. Herbage density declined with increasing pine canopy over the 29-year study.

9.
Baer, N., F. Ronco, Jr. and C.W. Barney. 1977. **Effects of watering, shading and size of stock on survival of planted lodgepole pine.** U.S.D.A. Forest Service, Research Note RM-347. 4 p.

During a summer with below normal precipitation, shade was found to increase survival of planted lodgepole pine. Larger stock survived better than smaller stock.

10.
Baker, F.S. 1949. **A revised tolerance table.** Journal of Forestry 47: 179-181.

Relative shade tolerances of native North American conifers and hardwoods are presented.

11.
Baron, F.J. 1962. **Effects of different grasses on ponderosa pine seedling establishment.** U.S.D.A. Forest Service, Research Note PSW-199. 8 p.

Ponderosa pine was established successfully on a burn site when planted or direct-seeded simultaneously with grass. Pine plantings 2 and 3 years after grass seeding were progressively poorer. Grass species differed in their effect on tree survival.

12.
Bartos, D.L. and W.F. Mueggler. 1982. **Early succession following clearcutting of aspen communities in northern Utah.** Journal of Range Management 35: 764-768.

Aspen suckers increased from 2300 per hectare prior to cutting to a maximum of 44000 per hectare by the second post-cut year. Undergrowth production on the cut units increased from 1013 kg/ha before logging to 3000 kg/ha after three growing seasons. Clearcutting increased the proportion of shrubs and decreased the proportion of forbs in the undergrowth.

13.
Basile, J.V. and C.E. Jensen. 1971. **Grazing potential on lodgepole pine clearcuts in Montana.** U.S.D.A. Forest Service, Research Paper INT-98. 11 p.

Multiple regression analysis is used to predict the expected composition, yield, and persistence of forage on lodgepole pine clearcuts on the basis of selected environmental factors.

14.
Beaton, J.D. 1959. **The influence of burning on the soil in the timber range area of Lac le Jeune, British Columbia. I. Physical properties II. Chemical properties.** Canadian Journal of Soil Science 39(1): 1-11.

Burning reduced total porosity, infiltration rate, acidity, organic matter, total nitrogen, and carbon dioxide-soluble phosphorus content. Capillary pore space, bulk density, soil temperature, total phosphorus, and carbon dioxide-soluble calcium content were increased.

15.
Berglund, E.R. 1976. **Seeding to control erosion along forest roads.** Oregon State University, Corvallis. Extension Circular No. 885. 19 p.

Seeding techniques and grass/legume mixes used in Oregon forests for soil stabilization and forage production are described.

16.
Bethlahmy, N. 1960. **Fertilizer helps establish grass seedings on abandoned logging roads.** Journal of Forestry 58: 965-966.

Fertilization with nitrogen, phosphorus, and potassium significantly increased vegetative establishment and cover on logging roads in the western Cascades of Oregon.

17.
Beveridge, A.E. and B.K. Klomp. 1973. **Tolerance of *Pinus radiata* to grass competition.** New Zealand Journal of Forestry 18: 148-151.

Large planting stock of radiata pine successfully withstood weed competition and animal damage on grazable woodland in New Zealand.

18.
Beveridge, A.E., B.K. Klomp and R.L. Knowles. 1973. **Grazing in young plantations of radiata pine established after clearing logged and reverted indigenous forest.** New Zealand Journal of Forestry 18: 152-156.

Cattle grazing in radiata pine plantations in New Zealand did not cause significant damage to crop trees. Management included provision of adequate water, well-distributed stock licks, and removal of livestock at first signs of feed shortage.

19.
Black, H.C. (editor). 1969. **Wildlife and reforestation in the Pacific Northwest.** Proceedings of a symposium held September 12-13, 1968. Oregon State University, Corvallis. 181 p.

This collection of papers deals with various aspects of wildlife/forestry interaction, including livestock/wildlife competition on forest-range, the influence of forest management on wildlife populations, and wildlife damage to coniferous regeneration.

20.
Blackmore, D.G. and W.M. Corns. 1979. **Lodgepole pine and white spruce establishment after glyphosate and fertilizer treatments of grassy cutover forest land.** Forestry Chronicle 55(3): 102-105.

Glyphosate and fertilizer treatments significantly increased shoot growth of lodgepole pine, but not of white spruce. Fertilizer treatments alone increased growth of both species. It was suggested that glyphosate had an inhibiting effect on promotion of spruce growth by fertilization.

21.
Blair, R.M. 1982. **Growth and nonstructural carbohydrate content of southern browse species as influenced by light intensity.** Journal of Range Management 35: 756-760.

Three species of palatable deer browse on loblolly pine/ shortleaf pine range were grown under three levels of radiation intensity. Twig growth and biomass were generally poorest in full sunlight, whereas foliar and root biomass were poorest in deep shade. Dry weight per unit leaf area and concentration of total nonstructural carbohydrate in leaves decreased for all species as light intensity declined.

22.
Boyer, W.D. 1967. **Grazing hampers development of longleaf pine seedlings in southwest Alabama.** Journal of Forestry 65(5): 336-338.

Light grazing by cattle resulted in seedling mortality equivalent to 23% of the original stand, and reduced root collar diameter growth of survivors by 13%. However, tree stocking levels were not significantly different between grazed and ungrazed plots.

23.
Brown, T.C. and D.R. Carder. 1977. **Sustained yield of what?** Journal of Forestry 75(11): 722-723.

Authors recommend that the policy focus of the U.S. National Forest Management Act should be shifted from individual outputs to maximum sustained yield of the total value of forest output.

24.
Campbell, R.S. 1954. **Fire in relation to forest grazing.** Unasylva 8(4): 154-158.

Author reports that excessive use of fire, especially when accompanied by overgrazing or shifting cultivation, degrades both plant cover and soil. The development and application of a fire policy for forest-range are discussed.

25.
Carder, D.R. 1977. **Multi-resource management research in the southwest - the Beaver Creek program.** Journal of Forestry 75(9): 582-584.

Thinning dense ponderosa pine stands in the Beaver Creek watershed, Arizona, increased water, forage, and wood yields.

26.
Carmean, W.H. 1971. **Large, well balanced stock and control of grass competition needed for red pine plantings on sandy soils.** Tree Planters' Notes 22: 8-10.

Large red pine seedlings survived better than smaller stock on glacial sands in Minnesota. However, the author also recommends that competition from herbaceous vegetation for soil moisture should be controlled prior to, and for 2 years after, planting.

27.
Carr, W.W. 1980. **A handbook for forest roadside erosion control in British Columbia.** B.C. Ministry of Forests, Land Management Report No. 4. 33 p.

Guidelines are provided for revegetating forest soils disturbed by management activities. Criteria for selecting appropriate grass/legume seed mixes are discussed.

28.
Carr, W. W. and S. Homoky. 1980. **The rehabilitation of severely disturbed land.** In Proceedings of the Research Activities Meeting, Volume 2, Silviculture. B.C. Ministry of Forests, Research Branch, Victoria, pp. 10-16.

On Vancouver Island, grass-legume establishment increased site nitrogen capital and enhanced foliar nitrogen levels of planted Douglas-fir seedlings on disturbed forestland.

29.
Cassady, J.T., W. Hopkins and L.B. Whitaker. 1955. **Cattle damage to pine seedlings.** U.S.D.A. Forest Service, Southern Forest Experiment Station. Occasional Paper No. 141. 14 p.

Data collected between 1946 and 1955 on cattle damage to tree seedlings in Louisiana pine plantations are reported. Authors recommend control of cattle distribution, numbers, and grazing period to protect pine regeneration.

30.
Chernoff, J.F. 1976. **Scarification and forage crop seeding as an attempt to improve seed-bed conditions in the interior Douglas-fir zone of the Cariboo Forest District.** B.S.F. thesis, University of British Columbia, Vancouver. 36 p.

Author reports preliminary results of ongoing scarification and forage seeding trials in the Cariboo, British Columbia. Survival and growth of conifer regeneration and seeded forages over the long term were not assessed.

31.
Christ, J.H. 1934. **Reseeding burned-over lands in northern Idaho.** University of Idaho, Moscow. Agricultural Experiment Station Bulletin No. 201. 28 p.

Guidelines are presented for seeding domestic forages on burned coniferous forestland in Idaho. The results of adaptation trials with various grasses and legumes are also described.

32.
Christensen, M.D., J.A. Young and R.A. Evans. 1974. **Control of annual grasses and revegetation in ponderosa pine woodlands.** Journal of Range Management 27(2): 143-145.

Application of the herbicide atrazine controlled cheatgrass sufficiently to permit establishment of intermediate wheatgrass. Higher rates of atrazine reduced competition from most herbaceous vegetation and resulted in greater growth of pine seedlings.

33.
Clark, M.B. 1973. **Compatibility of conifers and grass seeding.** Unpublished report, B.C. Forest Service, Research Section, Kamloops, B.C. 19 p.

Research conducted co-operatively by the B.C. Ministry of Forests and Agriculture Canada on the compatibility of tree and grass seeding is described. Results were inconclusive because of poor germination and establishment of seeded grasses and conifers. However, it was observed that sown grasses inhibited conifer, shrub, and native forb establishment.

34.
Clark, M.B. 1975. **Grass-conifer compatibility: a problem analysis.** Unpublished report, B.C. Forest Service, Research Section, Kamloops, B.C. 22 p.

Author discusses results of published studies on grass-conifer compatibility, and concludes that integrated use for timber and forage production is possible within Douglas-fir forests of British Columbia provided range management principles are applied. Research needs are identified.

35.
Clark, M.B. 1981. **Forest and range interactions.** Paper presented at the 72nd Western Forestry Conference, Western Reforestation Technical Sessions, Sun Valley, Idaho, Dec. 1-3. 9 p.

Observations and research on tree/grass/cattle interactions in the Pacific Northwest are summarized, and several problems affecting long-term planning and management are identified. Author concludes that, in general, livestock and timber production are compatible, provided co-operation exists between managers and users of the resource.

36.
Clark, M.B. and A. McLean. 1974. **Compatibility of grass seeding and coniferous regeneration on clearcuts in the south central interior of British Columbia.** B.C. Forest Service, Research Note No. 63. 10 p.

Authors describe field experiments investigating the effects of non-rhizomatous domestic grasses and cattle grazing on the establishment, survival, and growth of lodgepole pine and spruce on clearcuts in the Kamloops Forest District. Controlled cattle grazing had negligible impact on conifer seedlings and seeded grasses generally had no effect on conifer germination or survival.

37.
Clark, M.B. and A. McLean. 1975. **Growth of lodgepole pine seedlings in competition with different densities of grass.** B.C. Forest Service, Research Note No. 70. 8 p.

Under growth-room conditions, the survival, height, and phytomass of lodgepole pine decreased significantly as density of orchardgrass increased. Non-rhizomatous orchardgrass was found to be more competitive with lodgepole pine than native, rhizomatous pinegrass.

38.
Clark, M.B. and A. McLean. 1978. **Compatibility of grass seeding and coniferous regeneration of clearcuts in the south central interior of British Columbia.** B.C. Forest Service, Research Note No. 83. 25 p.

Authors conclude that trees and grass are compatible provided that co-operation exists among managers and users of the forest's resources. It is stated that the degree of forage utilization and the period of time when the forage is utilized are the most critical factors in the overall question of tree/grass compatibility.

39.
Clark, M.B. and A. McLean. 1979. **Growth of lodgepole pine seedlings in competition with grass.** B.C. Forest Service, Research Note No. 86. 13 p.

Survival of lodgepole pine was not affected by density or species of grass, but early height growth of pine and total seedling weight were significantly reduced by high grass seeding rates. Fertilization had no significant effect on grass productivity after the 1st year following application.

40.
Clary, W.P. 1979. **Grazing and overstory effects on rotationally burned slash pine plantation ranges.** Journal of Range Management 32(4): 264-266.

Light, moderate, and heavy grazing did not affect total herbage production, but heavy grazing altered forage species composition and reduced tree basal area. Increasing tree dominance decreased herbage production.

41.
Clary, W.P. and W.H. Kruse. 1979. **Phenology and rate of height growth of some forbs in the southwestern ponderosa pine type.** U.S.D.A. Forest Service, Research Note RM-376. 8 p.

Two of six primary forb species had possible value as range readiness indicators on forest-range, particularly common dandelion. Research on 24 secondary forb species showed that palatable green forage was available throughout the growing season.

42.
Clary, W.P., P.F. Ffolliott and F.R. Larson. 1978. **Factors affecting forage consumption by cattle in Arizona ponderosa pine forests.** Journal of Range Management 31(1): 9-10.

Forage consumption was significantly correlated with forage production and tree density, but not with steepness of slope, rockiness of soil, or distance from water.

43.
Clary, W.P., W.H. Kruse and F.R. Larson. 1975. **Cattle grazing and wood production with different basal areas of ponderosa pine.** Journal of Range Management 28(6): 434-437.

Ponderosa pine stands were thinned to various basal areas to determine the effects on beef and wood production. Beef gain potential decreased with increasing basal area.

44.
Crane, M.F., J.R. Habeck and W.C. Fischer. 1983. **Early postfire revegetation in a western Montana Douglas-fir forest.** U.S.D.A. Forest Service, Research Paper INT-319. 31 p.

Five years after a postfire seeding of orchardgrass, tall fescue, smooth brome, intermediate wheatgrass, and pubescent wheatgrass, the most competitive species were observed to be orchardgrass and native pinegrass. Recovery of understory vegetation was more rapid in ravines than on upland sites.

45.
Croker, T.C. 1975. **Longleaf pine seedlings survive fire in clearcut strips.** U.S.D.A. Forest Service, Research Note SO-188. 3 p.

Longleaf pine seedlings in clearcut strips were found to suffer little mortality from prescribed burns of varying intensities.

46.
Crouch, G.L. 1969. **Deer and reforestation in the Pacific Northwest.** In Wildlife and reforestation in the Pacific Northwest. H.C. Black (editor). School of Forestry, Oregon State University, Corvallis, pp. 63-66.

Author describes the occurrence and seasonal distribution of deer browsing on conifer seedlings. Browsing effects and control measures are discussed.

47.
Crouch, G.L. 1974. **Interaction of deer and forest succession on clearcuttings in the coast range of Oregon.** In Wildlife and forest management in the Pacific Northwest. H.C. Black (editor). Oregon State University, Corvallis, pp. 133-138.

Deer use of clearcut blocks was found to peak shortly after logging and decline thereafter. High levels of deer use were associated with reduced height growth and stocking levels of Douglas-fir regeneration, but moderate use appeared to have little adverse impact.

48.
Crouch, G.L. 1982. **Pocket gophers and reforestation on western forests.** Journal of Forestry 80: 662-664.

Pocket gophers reportedly cause significant injury to ponderosa pine, Douglas-fir, and other coniferous regeneration after logging or wildfires in the Pacific Northwest. Author suggests that silvicultural practices that minimize habitat conditions favourable to gophers may be the most practical solution for preventing damage.

49.
Crouch, G.L. 1983. **Effects of commercial clearcutting of aspen on understory vegetation and wildlife habitat values in southwestern Colorado.** U.S.D.A. Forest Service, Research Paper RM-246. 8 p.

Understory production of all woody matter, particularly aspen sprouts, increased after canopy removal. Graminoid and forb utilization by cattle was significantly higher in clearcuts than unharvested areas. Cover of Kentucky bluegrass and blue wildrye was severely reduced by logging.

50.
Crouch, G.L. and M.A. Radwan. 1981. **Effects of nitrogen and phosphorus fertilizers on deer browsing and growth of young Douglas-fir.** U.S.D.A. Forest Service, Research Note PNW-368. 15 p.

Nitrogen increased browsing of terminal shoots and growth of trees the 1st year, but effects were nearly undetectable 2 years after treatment. No responses to phosphorus were detected. On one site, growth of competing grasses was greatly stimulated by fertilization.

51.
Currie, P.O. 1969. **Use seeded ranges in your management.** Journal of Range Management 22: 432-434.

Average weight of weaned calves was higher and gross income per calf larger from combined use of seeded and native range than from native ponderosa pine range alone. Forage quality and nutritive value were better on seeded ranges.

52.
Currie, P.O., C.B. Edminster and F.W. Knott. 1978. **Effects of cattle grazing on ponderosa pine regeneration in central Colorado.** U.S.D.A. Forest Service, Research Paper RM-201. 7 p.

Good range management practices, such as light to moderate grazing rates and provision of adequate water supplies for livestock, resulted in negligible damage to natural and artificial regeneration. To increase pine regeneration, the authors recommend a single planting of 3000 seedlings per hectare, or an initial planting of 1300 - 1500 seedlings per hectare and replanting areas of high mortality.

53.
Currie, P.O. and H.L. Gary. 1978. **Grazing and logging effects on soil surface changes in central Colorado's ponderosa pine type.** Journal of Soil and Water Conservation 33(4): 176-178.

Thirty-five years of grazing and winter logging did not cause serious erosion or soil degradation on ponderosa pine forest-range.

54.
Denham, A.C. 1959. **Compatibility of grass and trees on eastside Oregon and Washington forests.** Proceedings of the Society of American Foresters 1959: 164-166.

Author argues that forage seeding and timber production are generally compatible, and points out that grass seeding is important to retain forest grazing capacity, control soil erosion, and prevent invasion of weeds.

55.
Dimock, E.J. 1974. **Animal resistant Douglas-fir: how likely and how soon?** In Wildlife and forest management in the Pacific Northwest. H.C. Black (editor). Oregon State University, Corvallis, pp. 95-101.

Experimental work on genetic variation in Douglas-fir to control browsing damage by snowshoe hares and black-tailed deer is reviewed. Author believes that animal resistance can become a practical goal in tree breeding.

56.
Dodd, C.J.H., A. McLean and V.C. Brink. 1972. **Grazing values as related to tree-crown cover.** Canadian Journal of Forest Research 2(3): 185-189.

Estimates of tree-crown cover from aerial photographs were used to approximate herbage productivity. Results suggest that the technique may be useful in range surveys.

57.
Duffy, P.D. 1974. **Planting grass and pine for erosion control.** Tree Planters' Notes 25 (1): 10-13.

Competition between weeping lovegrass and loblolly pine was reduced by proper timing of fertilizer application in northern Mississippi.

58.
Dunwiddie, P.W. 1977. **Recent tree invasion of subalpine meadows in the Wind River mountains, Wyoming.** Arctic and Alpine Research 9(4): 393-399.

Expansion of forest encroachment was believed to be caused by cattle grazing, which reduced competition between tree seedlings and herbaceous vegetation.

59.
Duvall, V.L. and J.B. Hilmon. 1965. **New grazing research programs for southern forest ranges.** Journal of Range Management 18:132-136.

Authors briefly trace the history of forest grazing on southern pine ranges, describe the results of range experimentation to date, and discuss the range research program of the U.S. Forest Service at the time of publication.

60.
Duvall, V.L. and N.E. Linnartz. 1967. **Influences of grazing and fire on vegetation and soil of longleaf pine - bluestem range.** Journal of Range Management 20: 241-247.

Herbage yields and density were found to be greater on moderately or heavily grazed than ungrazed range. Botanical composition remained relatively constant under moderate use, but changed markedly on ungrazed and heavily grazed ranges. Grazing compacted soils, but insufficiently to impair herbage growth or accelerate erosion. Fire had little long-term effect.

61.
Duvall, V.L. and L.B. Whitaker. 1964. **Rotation burning: a forage management system for longleaf pine - bluestem ranges.** Journal of Range Management 17: 322-326.

Involves dividing a range unit into three subunits of equal grazing capacity, with one subunit burned each year in a 3-year rotation. Subunits are heavily grazed the year after the burn, followed by 2 years of lighter use to restore plant vigour. The system was found to improve forage palatability and nutritive content.

62.
Dyrness, C.T. 1967. **Grass-legume mixtures for roadside soil stabilization.** U.S.D.A. Forest Service, Research Note PNW-71. 19 p.

Adaptability of eight legume species to disturbed forest soils in the western Cascades, Oregon, is examined. The author also compares the performance of several grass-legume mixtures seeded in the same environment. Legume adaptability was generally found to be quite poor.

63.
Dyrness, C.T. 1973. **Early stages of plant succession following logging and burning in the western Cascades of Oregon.** Ecology 54: 57-69.

Changes in plant cover and species composition after clearcut logging and broadcast burning in old-growth Douglas-fir forest are described.

64.

Eddleman, L. and A. McLean. 1969. **Herbage - its production and use within the coniferous forest.** In Coniferous forests of the northern Rocky Mountains: proceedings of the 1968 symposium. Center for Natural Resources, University of Montana, Missoula, pp. 179-196.

Various aspects and problems of forest grazing in the Pacific Northwest are reviewed. The authors regard the ponderosa pine and Douglas-fir zones as principal multiple use areas because of their large extent and location, and argue that total productivity of a number of uses usually exceeds that of any single use. They advocate further study of timber/range relationships and make several research recommendations.

65.

Edgerton, P.J. 1971. **The effect of cattle and big game grazing on a ponderosa pine plantation.** U.S.D.A. Forest Service, Research Note PNW-172. 8 p.

After five growing seasons, grazing by deer, cattle, and elk had neither harmed nor benefitted survival and growth of planted ponderosa pine.

66.

Edgerton, P.J. 1983. **Response of the bitterbrush understory of a central Oregon lodgepole pine forest to logging disturbance.** U.S.D.A. Forest Service, General Technical Report INT-152, pp. 99-106.

Average crown cover of bitterbrush before logging and 2 and 5 years afterwards was 15.1, 4.3, and 20.1%, respectively. The substantial recovery was due to increased twig growth of surviving shrubs and establishment of shrub seedlings on disturbed soils.

67.

Eis, S. 1965. **Development of white spruce and alpine fir seedlings on cut-over areas in the central interior of British Columbia.** Forestry Chronicle 41(4): 419-431.

Regeneration of white spruce and alpine fir on logged areas in north central British Columbia is described, with particular emphasis on the effects of site, seedbed composition, soil moisture, soil surface, and air temperature on germination, survival, and 1st-year growth.

68.
Eis, S. 1981. **Effect of vegetative competition on regeneration of white spruce.** Canadian Journal of Forest Research 11: 1-8.

Plant succession after logging was studied on four forest site types in north central British Columbia. On three sites, 6-7 years elapsed before vegetation became a hindrance to regeneration, and spruce seedlings were able to withstand competition by this time. On an alluvial site, however, spruce seedlings were overtopped during the first growing season and eliminated as the density of shrubs increased.

69.
Eissenstat, D.M., J.E. Mitchell and W.W. Pope. 1982. **Trampling damage by cattle on northern Idaho forest plantations.** Journal of Range Management 35: 715-716.

Douglas-fir trees partially girdled by trampling had a higher mortality rate than untrampled seedlings. Authors add that Douglas-fir appears to be more sensitive to trampling damage than other commercially valuable conifers, such as slash pine.

70.
Ellison, L. and W.R. Houston. 1958. **Production of herbaceous vegetation in openings and under canopies of western aspen.** Ecology 39: 337-345.

Field experiments demonstrated that root competition was the principal factor reducing herbage yields under trembling aspen canopies in central Utah.

71.
Evanko, A.B. 1953. **Forage species and planting season for reseeding cleared and abandoned ponderosa pine areas in northeastern Washington.** U.S.D.A. Forest Service, Northern Rocky Mountain Forest and Range Experiment Station, Research Note 119. 5 p.

Spring and fall plantings of 30 forage species and strains are evaluated. Several species, including seven wheatgrasses and orchardgrass, were well adapted when planted in the spring.

72.
Evanko, A.B. 1953. **Performance of several forage species on newly burned lodgepole pine sites.** U.S.D.A. Forest Service, Northern Rocky Mountain Forest and Range Experiment Station, Research Note 133. 7 p.

Adaptation trials of 18 forage species indicated that big bluegrass, sheep fescue, redtop, and timothy were able to persist on dry, southwest exposed sites. Under more favourable soil and moisture conditions on a north-facing slope, these species plus tall oatgrass, pubescent wheatgrass, smooth bromegrass, orchardgrass, and beardless bluebunch wheatgrass performed satisfactorily.

73.
Ffolliott, P.F. and W.P. Clary. 1975. **Differences in herbage relationships on sedimentary and igneous soils in Arizona ponderosa pine stands.** Progressive Agriculture in Arizona 27(3): 6-7.

Significant differences in herbage-timber relationships on sedimentary and igneous soils were observed, suggesting that predictions of herbage production that do not account for soil variation may not be sufficiently accurate for use in land management planning.

74.
Ffolliott, P.F., W.P. Clary and M.B. Baker, Jr. 1976. **Characteristics of the forest floor on sandstone and alluvial soils in Arizona's ponderosa pine type.** U.S.D.A. Forest Service, Research Note RM-308. 4 p.

Forest floor depths and weights under ponderosa pine stands on sandstone and alluvial soils derived from sedimentary parent materials were not significantly different from those on soils developed from volcanic parent materials.

75.
Ffolliott, P.F., W.P. Clary and F.R. Larson. 1977. **Effects of a prescribed fire in an Arizona ponderosa pine forest.** U.S.D.A. Forest Service, Research Note RM-336. 4 p.

Eleven years after a prescribed fire, which consumed nearly three-quarters of the total forest floor, more pine seedlings had established on the burned areas than under adjacent unburned stands. Herbage production had increased, but not to levels adequate for grazing. Herbage composition changed from unpalatable to palatable species.

76.
Ffolliott, P.F. and D.B. Thorud. 1977. **Water resources and multiple-use forestry in the southwest.** Journal of Forestry 75: 469-471.

Thinning the forest overstory improved water yields, forage production, and wildlife habitat in ponderosa pine forests in Arizona.

77.
Fisher, R.F. 1980. **Allelopathy: a potential cause of regeneration failure.** Journal of Forestry 78(6): 346-350.

The literature on allelopathy is reviewed. Author concludes that allelopathic interference is quite important in the survival and growth of trees in both plantations and natural stands, and argues that an awareness of the phenomenon is essential in the practice of intensive silviculture.

78.
Forest-Range Task Force. 1972. **The nation's range resources - a forest-range environmental study.** U.S.D.A. Forest Service, Washington, D.C. Forest Resource Report No. 19. 147 p.

A scheme is presented for categorizing forest-range in the 48 coterminous United States into major ecosystems. These ecosystems are further sub-divided into resource units according to ownership, productivity, and condition. An analytical system incorporating environmental and social considerations was developed to suggest management mixes to achieve national goals for forest-range livestock production at minimum cost.

79.
Fowells, H.A. 1965. **Silvics of forest trees of the United States.** U.S.D.A. Forest Service, Agricultural Handbook No. 271.

The autecology, biogeography, life history, and habitats of North American conifers and hardwoods are described.

80.
Franklin, J.F., W.H. Moir, G.W. Douglas and C. Wiberg. 1971. **Invasion of subalpine meadows by trees in the Cascade Range, Washington and Oregon.** Arctic and Alpine Research 3(3): 215-224.

Fire, grazing, and forest edge effect are considered as possible agents influencing the invasion of subalpine fir and mountain hemlock into montane meadows between 1928 and 1937. However, the authors suggest that climatic change is the most probable causative factor.

81.
Freyman, S. and A.L. van Ryswyk. 1969. **Effect of fertilizer on pinegrass in southern British Columbia.** Journal of Range Management 22(6): 390-395.

Ammonium nitrate applied at 100 and 200 kg N/ha increased the yield, forage quality, and palatability of pinegrass. These responses were accentuated when sulfur in the form of gypsum was applied with nitrogen. Fertilization extended the nutritive value of pinegrass over the grazing season.

82.
Garrison, G.A. 1960. **Recovery of ponderosa pine range in eastern Oregon and eastern Washington by the seventh year after logging.** Proceedings of the Society of American Foresters 1960: 137-149.

The slow recovery of native vegetation on ponderosa pine range following timber harvest is documented. The author recommends further study of (1) domestic grass seeding to control erosion, (2) alternatives to slash burning, which tends to retard succession, and (3) measures to restore deteriorated soil structure.

83.
Garrison, G.A. and R.S. Rummell. 1951. **First-year effects of logging on ponderosa pine forest rangelands of Oregon and Washington.** Journal of Forestry 49: 708-713.

Tractor logging denuded the herbaceous and shrub cover from about 21% of the ground, and covered an additional 5% with slash. Authors estimate that this degree of damage caused a 33% reduction in the density of herbs and shrubs.

84.
Geist, J.M. 1976. **Orchardgrass growth on nitrogen and sulfur fertilized volcanic ash.** Journal of Range Management 29(5): 415-418.

Fertilizer sources with soluble sulfur are reported to be superior to those with elemental sulfur in producing faster growth and greater nitrogen recovery of orchardgrass. The author suggests that rapid early growth will take optimum advantage of stored soil moisture prior to onset of the dry summers which typically occur in much of the Pacific Northwest.

85.
Gesshe, R.H. and P.D. Walton. 1981. **Grazing animal preferences for cultivated forages in Canada.** Journal of Range Management 34: 42-45.

The advantages of mixed forage stands over monospecific pastures are demonstrated in terms of animal preference and production. Plant moisture, crude protein, digestibility, and crude fibre influenced preference at certain times of the growing season.

86.
Gillen, R.L., W.C. Krueger and R.F. Miller. 1984. **Cattle distribution on mountain rangeland in northeastern Oregon.** Journal of Range Management 37: 549-553.

Riparian meadows were reported to be the most preferred vegetation types, followed by logged forest communities when available. Relatively open ponderosa pine/Douglas-fir ranges were the most utilized forest habitats, while the densely timbered grand fir sites were least preferred.

87.
Gillen, R.L., W.C. Krueger and R.F. Miller. 1985. **Cattle use of riparian meadows in the Blue Mountains of northeastern Oregon.** Journal of Range Management 38(3): 205-209.

Given that up to 80% of the forage consumed on some ponderosa pine/Douglas-fir forest-ranges may come from riparian meadows, the intensity and pattern of cattle use on these areas under continuous and deferred rotation grazing management were studied. The authors conclude that early and continuous grazing treatments seem to be most detrimental to meadow plants.

88.
Gjertson, J.O. 1949. **Practical guides for seeding grass on skid roads, trails and landings following logging on east-side forests of Washington and Oregon.** U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station, Research Note 49. 5 p.

Author discusses seedbed requirements, site preparation, species selection, and seeding time for establishing domestic grasses on disturbed forest-range. Post-seeding grazing management is also considered.

89.
Glen, L.M. 1979. **Drag scarification in British Columbia.** B.C. Ministry of Forests, Information Services Branch, Victoria. 60 p.

This handbook outlines the objectives and application of drag scarification as a silvicultural technique for site preparation and forest regeneration.

90.
Gordon, D.T. 1962. **Growth response of east side pine poles to removal of low vegetation.** U.S.D.A. Forest Service, Research Note PSW-209. 3 p.

Ponderosa and Jeffrey pine saplings grew faster when perennial bunchgrass was removed than when bunchgrass plus broad-leaved shrubs or broad-leaved shrubs alone were eliminated.

91.
Grelen, H.E. 1976. **Responses of herbage, pines and hardwoods to early and delayed burning in a young slash pine plantation.** Journal of Range Management 29(4): 301-303.

Early burning did not prevent herbage yields from decreasing sharply as the overstory developed. However, it kept hardwoods and shrubs from reaching a size uncontrollable by fire, maintained accessibility of browse for cattle and deer, and prevented pine litter from eliminating herbaceous plants from the understory. Burning had no effect on pine survival or growth.

92.
Grelen, H.E. 1978. **Forest grazing in the south.** Journal of Range Management 31(4): 244-250.

The literature on livestock grazing in slash and loblolly pine plantations in the southern United States is reviewed. The author advocates operational-scale, multiple-use research to evaluate the compatibility of cattle, wildlife, and other resources.

93.
Grelen, H.E. and H.G. Enghardt. 1973. **Burning and thinning maintain forage in a longleaf pine plantation.** Journal of Forestry 71: 419-425.

Positive correlations were found between thinning intensity and herbage production. Prescribed fires at 5 year intervals controlled development of shrubs and understory hardwoods.

94.
Grelen, H.E. and L.B. Whitaker. 1973. **Prescribed burning rotations on pine - bluestem range.** Journal of Range Management 26(2): 152-153.

A winter burning rotation is recommended for forage management on forested or clearcut native range in the longleaf-slash pine timber type of Louisiana.

95.
Grelen, H.E., L.B. Whitaker and R.E. Lohrey. 1972. **Herbage response to precommercial thinning in direct-seeded slash pine.** Journal of Range Management 25: 435-437.

Herbage yields were observed to be inversely related to tree basal area. Grasses dominated the understory on heavily thinned plots, while forbs were most prominent in densely timbered areas.

96.
Hall, F.C. 1966. **Ecology as a tool in multiple-use management on forested areas.** Proceedings of the Society of American Foresters 1966: 224-228.

Author points out that since forests yield multiple products, they require multiple use management. It is suggested that the role of ecology in multiple use management is to classify and characterize plant communities, thus providing a basis for analyses of land capability and site productivity.

97.
Hall, F.C. 1975. **Range management as a counterpart of forest management.** In Range: multiple use management. B. Roche, Jr. (editor). Washington State University, Pullman, pp. 49-63.

On the basis of ecological characteristics, it is predicted how mixed conifer/pinegrass plant communities in the Pacific Northwest react to: 1) thinning stagnated ponderosa pine; 2) high risk selection cutting of old-growth pine with a fir understory; and 3) grass seeding and tree planting on clearcuts. Techniques are proposed for prescribing management treatments to attain a desired timber stand and range condition.

98.
Hall, F.C. 1978. **Applicability of rangeland management concepts to forest-range in the Pacific Northwest.** Proceedings of the International Rangelands Congress 1: 496-499.

Author argues that the concepts of range condition and trend are not well suited to forest-range in the Pacific Northwest because (1) tree crown cover causes a "downward trend" in range "condition" unrelated to grazing, and (2) timber management results in changes in range vegetation, independent of animal use.

99.
Hall, F.C. 1983. **Application and interpretation of forest ecosystems classification.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 7-14.

Author points out that range management uses plant associations for range condition guides, which are based on species density and composition. Condition classes place a limit on the variability in composition and density of dominant species permissible in the classification of plant associations.

100.
Hanson, G.F. 1974. **Cattle and timber management in the conifer/pinegrass stands of British Columbia.** B.S.F. thesis, University of British Columbia, Vancouver. 29 p.

The interactions among trees, cattle, and forage in the Douglas-fir/pinegrass and lodgepole pine/pinegrass associations of southern British Columbia are discussed. Author suggests that compatibility can be achieved through improved management of timber and cattle.

101.
Heady, H.F. 1964. **Palatability of herbage and animal preference.** Journal of Range Management 17: 76-82.

This review paper defines herbage palatability and animal preference, examines the factors influencing each, and discusses the effects of preferential grazing on vegetational change.

102.
Hedrick, D.W. 1958. **Proper utilization - a problem in evaluating the physiological response of plants to grazing use: a review.** Journal of Range Management 11: 34-43.

Literature on the physiological aspects of range and pasture use is reviewed to identify a basis for developing proper use standards applicable to both native and improved forage species. The author also considers some of the important factors influencing forage use.

103.
Hedrick, D.W. 1966. **Forest grazing in northeastern Oregon.** Oregon State University, Corvallis. Agricultural Experiment Station, Special Report No. 215, pp. 13-17.

Research conducted from 1955 to 1966 at the Eastern Oregon Experiment Station is summarized. Author concludes that there is a high potential for both forage and timber production on ash-covered sites supporting mixed coniferous stands, but emphasizes that close collaboration of forest and range managers is required in planning improvement programs to realize this potential.

104.
Hedrick, D.W. 1975. **Grazing mixed conifer forest clearcuts in northeastern Oregon.** Rangeman's Journal 2(1): 6-9.

Experimental work on forest grazing conducted by researchers at Oregon State University is summarized. The author proposes livestock management practices for minimizing damage to coniferous regeneration and sustaining forage productivity.

105.
Hedrick, D.W., B.R. Eller, J.A.B. McArthur and R.D. Pettit. 1969. **Steer grazing on mixed coniferous forest ranges in northeastern Oregon.** Journal of Range Management 22: 322-325.

Cattle performance and weight gains were measured on pinegrass ranges. It was found that best animal performance coincided with maximum vegetative development, but early grazing was necessary to fully utilize pinegrass and legumes. Browse was valuable in the fall.

106.
Hedrick, D.W., J.A. Young, J.A.B. McArthur and R.F. Keniston. 1968. **Effects of forest and grazing practices on mixed coniferous forests of northeastern Oregon.** Agricultural Experiment Station, Oregon State University, Corvallis. Technical Bulletin 103. 24 p.

Authors report the results of a study designed to (1) clarify the relationship between forest overstory and forage, (2) compare forage production on logged and unlogged units, and (3) determine ways of improving forage utilization in mixed coniferous forest. As overstory increased, production and quality of forage decreased. Browse and herbage increased where logging created openings, but some areas were taken out of production by heavy soil disturbance and slash accumulations. Livestock distribution and forage utilization were improved by stocking suitable classes of cattle, range riding, and proper seasonal use.

107.
Heerwagen, A. 1954. **The effect of grazing use upon ponderosa pine reproduction in the Rocky Mountain area.** Proceedings of the Society of American Foresters 1954: 206-207.

Author indicates that moderate grazing use, coupled with provision for preventing livestock concentration, not only results in negligible damage to pine reproduction, but is of silvicultural benefit in reducing herbaceous competition and fire hazard. Excessive grazing, however, severely damages regeneration, decreases forage production, and induces soil erosion.

108.
Helvey, J.D. and W.B. Fowler. 1979. **Grass seeding and soil erosion in a steep, logged area in northeastern Oregon.** U.S.D.A. Forest Service, Research Note PNW-343. 11 p.

Grass seeding had little or no effect on soil surface changes, possibly because no intense precipitation events were experienced during the study period. Grass seeding appeared to have a negative impact on the rate of recolonization by native plants.

109.
Hess, J.P. 1966. **Management of livestock grazing on private timberland.** Proceedings of the Society of American Foresters 1966: 231-232.

Author emphasizes that livestock grazing on commercial tree farms is secondary in importance to timber production. However, he believes that controlled livestock grazing does not adversely effect tree establishment. The advantages and disadvantages to the timber company of multiple resource management are discussed.

110.
Hess, J.P. 1983. **Forestland grazing policy and practices on private timberlands in central Washington.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 101-103.

Livestock grazing on Boise Cascade timberlands is described. The author concludes that the investment in plantation or natural regeneration effort is too great to allow grazing damage to occur at any stage of reproduction. Nevertheless, it is noted that co-ordinated resource planning has aided in achieving proper livestock grazing on private timberland.

111.
Hetzel, G.E. 1983. **The economics of planning forestland grazing management in association with timber production and other associated uses.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 67-70.

Author points out that it is important to identify the true costs of livestock grazing in relation to the benefits that accrue from range improvement investments. Cost-effective analysis procedures for determining economic efficiency, environmental quality, and secondary values of alternative range management practices are discussed.

112.
Hilton, J.E. and A.W. Bailey. 1972. **Cattle use of a sprayed aspen parkland range.** Journal of Range Management 25(4): 257-260.

Aspen parkland range in central Alberta that was treated with herbicide 2 years prior to study had greater grazing use than untreated forest-range. This was believed to be related to increased forage production following control of aspen growth.

113.
Hobbs, E.E. 1954. **A study of lodgepole pine and its effect on timber range management.** B.Sc. thesis, University of British Columbia, Vancouver. 15 p.

The life history and ecology of lodgepole pine is briefly described, and an early perspective on the value of this forest type for range purposes is given. The author identifies some disadvantages to grazing lodgepole pine ranges, and notes that the practice generated considerable controversy among foresters and ranchers in the early 1950's.

114.
Hodgkins, E.J. 1958. **Effects of fire on undergrowth vegetation in upland southern pine forests.** Ecology 39: 36-46.

Author concludes that the successional pattern after fire is primarily associated with the seeding and sprouting habits of the forbs, grasses, and woody species involved, as well as the abilities of the plant forms to develop in size.

115.
Holechek, J.L. and M. Vavra. 1983. **Fistula sample numbers required to determine cattle diets on forest and grassland ranges.** Journal of Range Management 36: 323-326.

A minimum of four esophageal fistulated cattle and four collections were needed to adequately sample diets on grassland and forest-range. Authors note that collections should be rotated between morning and afternoon to assess diurnal changes in botanical composition and nutritive quality of the diets.

116.
Holechek, J.L. and M. Vavra. 1983. **Drought effects on diet and weight gains of yearling heifers in northeastern Oregon.** Journal of Range Management 36: 227-231.

Livestock weight gains and forage intake in the latter part of the grazing season were reduced on ponderosa pine range during a drought year. This was attributed to depletion of browse. Authors suggest that ranges supporting a high component of palatable shrubs and forbs will improve weight gains during drought years.

117.
Holechek, J.L., M. Vavra and J. Skovlin. 1981. **Diet quality and performance of cattle on forest and grassland range.** Journal of Animal Science 53(2): 291-298.

Cattle diets on forest-range contained more crude protein in early and late summer than grasslands in the Blue Mountains of eastern Oregon. The authors suggest that grasslands may be used most efficiently in the spring and, given late summer precipitation for regrowth, in the fall. Forest-range is recommended for early and late summer grazing.

118.
Holechek, J.L., M. Vavra, J. Skovlin and W.C. Krueger. 1982. **Cattle diets in the Blue Mountains of Oregon. II. Forests.** Journal of Range Management 35(2): 239-242.

Grasses, forbs, and shrubs averaged 61, 16, and 23% of the diet, respectively. Browse comprised as much as 47% of the diet when green grass was unavailable. The authors conclude that cattle are opportunistic grazers and do not limit their selection to grass species on forest-range.

119.
Hormay, A.L. 1940. **The effects of logging on forage.** Chronica Botanica 6: 6-7.

The more palatable forbs and grasses on ponderosa pine range in northeastern California were most readily removed by logging.

120.
Horton, J.S. 1950. **Effect of weed competition upon survival of planted pine and chaparral seedlings.** U.S.D.A. Forest Service, California Forest and Range Experiment Station, Research Note 72. 6 p.

The presence of annual grasses and herbs reduced the survival of planted Coulter pine in southern California. Competition for water was believed to be the causative factor.

121.
Hoyles, S.E. 1977. **Forage species analysis on windrowed, burnt, scarified and untreated clearcuts in the lodgepole pine zone of the Kamloops Forest District.** B.Sc. thesis, University of British Columbia, Vancouver. 37 p.

On the basis of field trials in the Kamloops Forest Region, author reports that broadcast burning, when feasible, is the best method of site preparation for forage establishment.

122.
Hull, A.C., Jr. 1966. **Emergence and survival of intermediate wheatgrass and smooth brome seeded on a mountain range.** Journal of Range Management 19: 9279-283.

Low emergence and high mortality were observed in seeding trials in a spruce-fir forest opening in Idaho. Author emphasizes the need for additional research.

123.
Ingram, D.C. 1928. **Grazing as a fire prevention measure for Douglas-fir cut-over land.** Journal of Forestry 28: 998-1005.

Preliminary data indicated that 56% of all herbs and shrubs potentially grazable by sheep were utilized, thus reducing fire hazard and competition with tree seedlings. Better conifer seedling survival was observed on grazed than ungrazed plots.

124.
Ingram, D.C. 1931. **Vegetative changes and grazing use on Douglas-fir cut-over land.** Journal of Agricultural Research 43(5): 387-417.

Author argues that moderate grazing by sheep is not seriously inimical to forest regeneration, and is more than compensated for by the protection it affords through reduction in fire hazard.

125.
Jackman, R.E. and N.N. Stoneman. 1973. **Roadside grassing - a post-logging practice for redwood forests.** Journal of Forestry 71(2): 90-92.

The sowing of annual ryegrass with urea fertilizer to provide a quick, dense vegetative cover on logging roads, landings, and skidtrails in California is described.

126.
Jameson, D.A. 1966. **Pinyon-juniper litter reduces growth of blue grama.** Journal of Range Management 19: 214-217.

Multiple regression analyses showed that tree litter, rather than light interception by the tree canopy, was the major factor in reducing growth of blue grama grass.

127.
Jameson, D.A. 1967. **Relationship of tree overstory and herbaceous understory vegetation.** Journal of Range Management 20: 247-249.

A mathematical formula is presented, based on a five-parameter transition sigmoid growth curve, which fits overstory-understory data from ponderosa pine forests better than previously used equations.

128.
Johnson, M.G. and R.L. Beschta. 1980. **Logging, infiltration capacity, and surface erodibility in western Oregon.** Journal of Forestry 78: 334-337.

Three to 6 years after timber harvest, infiltration capacity and erodibility values on logged portions were not significantly different from those on unlogged sites. Heavily disturbed areas, such as landings and skidtrails, had reduced infiltration capacity and increased surface erodibility, but showed a distinct trend toward prelogging conditions.

129.
Jones, K.L. 1983. **Current knowledge of the effects of cattle grazing on aspen in the Alberta parkland.** Rangelands 5(2): 59-60.

The role of cattle in controlling the expansion of woody species on Alberta grasslands is briefly described.

130.
Jurgensen, M.F., A.E. Harvey and M.J. Larsen. 1981. **Effects of prescribed fire on soil nitrogen levels in a cutover Douglas-fir/western larch forest.** U.S.D.A. Forest Service, Research Paper INT-275. 6 p.

Soil N losses from burning were about 6% of the total nitrogen originally present in the surface 30 cm of soil. Soil ammonium and nitrate concentrations increased after the fire, but returned to preburn levels by the end of the following summer.

131.
Kearl, L.C., N.C. Frischknecht and L.E. Harris. 1971. **Wheatgrass, native grass and forest grazed by cattle.** Proceedings of the American Society of Animal Science, Western Section 22: 63-69.

Authors compared different grazing systems involving crested wheatgrass, native wheatgrass, and forest-range in Utah. Cows grazing on forested and native grassland ranges finished the season 20-30 kg heavier than cows on crested wheatgrass pasture.

132.
Kidd, W.J., Jr. and H.F. Haupt. 1968. **Effects of seedbed treatment on grass establishment on logging road beds in central Idaho.** U.S.D.A. Forest Service, Research Paper INT-53. 9 p.

Scarification, mulch, and fertilizer treatments are compared. Grass density was increased by scarification and decreased by mulch, while fertilization yielded no significant improvement in plant density or cover.

133.
Kingery, J.L. 1983. **Research response to forestland grazing needs on public lands of the northern intermountain region.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 85-87.

Author points out that the great variability in research results concerning the impact of animal use on tree regeneration is not a function of the quality of the research, but rather of the specific conditions under which the observations were made. Site- and situation-specific conditions affect the establishment, growth, and vulnerability of tree species used for regeneration purposes.

134.
Klock, G.O., A.R. Tiedemann and W. Lopushinsky. 1975. **Seeding recommendations for disturbed mountain slopes in north central Washington.** U.S.D.A. Forest Service, Research Note PNW-244. 8 p.

Severely disturbed soil on firelines was successfully revegetated with orchardgrass, timothy, perennial ryegrass, smooth bromegrass, and tall fescue, out of 40 species tested. The authors prescribe seeding only one or two of these adapted species rather than a mix of all five, and recommend a starter fertilizer treatment.

135.
Kosco, B.H. 1981. **Combining forage and timber production in young-growth mixed conifer forest range.** Ph.D. thesis, University of California, Berkeley.

Brush cover in clearcuts was significantly reduced by cattle and deer. Although deer were responsible for some browsing damage to conifer regeneration, trampling damage was negligible. Injury attributable to cattle was not observed in this study.

136.
Kosco, B.H. and J.W. Bartolome. 1981. **Forest grazing: past and future.** Journal of Range Management 34(3): 248-251.

The history and future of forest grazing in the U.S. National Forests are briefly discussed, with particular emphasis on California. The authors conclude that the future depends on detailed inventories of land use capabilities and better management to minimize harmful interactions among conflicting uses.

137.
Kosco, B.H. and J.W. Bartolome. 1983. **Effects of cattle and deer on regenerating mixed conifer clearcuts.** Journal of Range Management 36: 265-268.

No trampling damage was observed, and browsing injury was attributed solely to deer. Browsing did not influence overall tree seedling height or basal diameter, but brush cover was significantly reduced on grazed treatments.

138.
Kranz, J.J. and R.L. Linder. 1973. **Value of Black Hills forest communities to deer and cattle.** Journal of Range Management 26: 263-265.

Understory production was inversely related to overstory density. Forage biomass was greatest under an aspen canopy, less under mixed aspen-ponderosa pine, and least under pure ponderosa pine. Aspen communities appeared to represent better feeding areas for both deer and cattle than mixed aspen-pine or pine.

139.
Krueger, W.C. 1981. **How a forest affects a forage crop.** Rangelands 3(2): 70-71.

Author discusses the physiological effects of light, moisture, and temperature, as modified by the forest canopy, on understory forage production.

140.
Krueger, W.C. 1983. **Cattle grazing in managed forests.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 29-41.

Twenty years of research on grazing in a Douglas-fir/ponderosa pine plantation in Oregon is summarized. Cattle distribution within home ranges was related to water, vertical rise above water, soil depth, slope, plant community, canopy cover, abundance of palatable forages, and logging roads. Plant community structure was influenced most by logging. Big game grazing was of secondary importance, while cattle grazing had the least impact on floristic structure. Seeded forages had no influence on survival or height of planted conifers, and tree height growth was greatest in a pasture grazed by cattle and big game.

141.
Krueger, W.C. and A.H. Winward. 1974. **Influence of cattle and big game grazing on understory structure of a Douglas-fir - Ponderosa pine - Kentucky bluegrass community.** Journal of Range Management 27(6): 450-453.

Heavy season-long use by cattle and big game resulted in apparent retrogression of the plant community. Cattle and big game grazing together substantially changed the floristic structure of the pasture, but big game alone had little impact on the community. Browse was reduced by both cattle and big game.

142.
Krueger, W.C. and A.H. Winward. 1976. **Effects of grazing and selective logging on a mixed coniferous forest.** Proceedings of the Oregon Academy of Science 1976: 27-35.

No significant changes in community structure were attributable exclusively to heavy cattle grazing, although grazing by big game or by cattle and big game together did alter secondary succession. Residual effects of logging had more total influence on community structure than grazing.

143.
Kruse, W.H. 1972. **Effects of wildfire on elk and deer use of ponderosa pine forest.** U.S.D.A. Forest Service, Research Note RM-226. 4 p.

After a wildfire, elk use shifted from an old seeded clearcut to a newly seeded burn for the first 2 years. The 3rd year showed a trend toward equitable use of the two habitats by elk. Deer use also increased in the burned areas until cattle grazing was reinstated 2 years after the fire.

144.
Lane, R.D. and A.L. McComb. 1948. **Wilting and soil moisture depletion by tree seedlings and grass.** Journal of Forestry 46: 344-349.

In greenhouse experiments, it was found that smooth bromegrass absorbed soil moisture more rapidly than black locust or green ash seedlings. Further, the permanent wilting percentage was lower for smooth brome than for the two trees. These results indicate the need for moisture-conserving treatments when tree seedlings are planted in heavily sodded sites.

145.
Larson, M.M. and G.H. Schubert. 1969. **Root competition between ponderosa pine seedlings and grass.** U.S.D.A. Forest Service, Research Paper RM-54. 12 p.

Mountain muhly, a warm-season bunchgrass, retarded root and top growth of ponderosa pine seedlings less than did Arizona fescue, a cool-season bunchgrass. Arizona fescue depleted soil moisture faster and to lower levels than mountain muhly, and reduced it to critical levels for plant growth during spring and fall droughts. The authors point out that height growth of pine seedlings is a poor indicator of competition, since most early growth occurs in the root system.

146.
Lay, D.W. 1957. **Browse quality and the effects of prescribed burning in southern pine forests.** Journal of Forestry 55: 342-347.

Burning increased protein content up to 43% and phosphoric acid content to 78%, but most of the benefits disappeared within a year or two. Author concludes that more permanent improvement in the quality of fall and winter diets is needed to achieve maximum carrying capacity.

147.
Lewis, C.E. 1980. **Simulated cattle injury to planted slash pine: girdling.** Journal of Range Management 33: 337-340.

Under controlled experimental conditions, it was noted that mortality of slash pine was negligible except after complete girdling. Height growth was reduced by 75% girdling, primarily on seedlings treated within 6 months after planting.

148.
Lewis, C.E. 1980. **Simulated cattle injury to planted slash pine: combinations of defoliation, browsing, and trampling.** Journal of Range Management 33(5): 340-345.

Survival and height growth were poorest when treatments were applied to pine seedlings within 6 months after planting. Mortality and height growth reductions were lower when older seedlings were treated. Only the severest combinations of injury permanently reduced height growth.

149.
Lewis, C.E. 1980. **Simulated cattle injury to planted slash pine: defoliation.** Journal of Range Management 33(5): 345-348.

Survival was excellent except when all needles were removed 6 months after planting. Reductions in height growth occurred only with the most severe levels of defoliation. Nevertheless, the greatest cumulative loss in height was less than 1 m over a 6 year period.

150.
Lewis, C.E. and T.J. Harshbarger. 1976. **Shrub and herbaceous vegetation after 20 years of prescribed burning in the South Carolina coastal plain.** Journal of Range Management 29: 13-18.

Percentage of ground cover, herbage yields, number of herbaceous species, and density of herbaceous plants increased with burning. Annual summer burning eliminated most shrubs, but winter burns and periodic summer burns were less effective.

151.
Lewis, C.E., W.C. McCormick and W.E. White. 1972. **Cultivation, grazing, insects and disease affect yield of slash pine planted in sod.** U.S.D.A. Forest Service, Research Note SE-174. 8 p.

Tree height and diameter growth was best on plots cultivated to reduce competing vegetation. However, damage by cattle, insects, and disease was much greater with cultivation, resulting in lower survival rates than on uncultivated plots.

152.
Logan, R.S. 1983. **Agro-forestry: growing trees, forage, and livestock together.** Oregon State University, Corvallis. Extension Circular No. 1114. 4 p.

Research from New Zealand and Oregon is briefly discussed. Author concludes that agro-forestry is both technically and economically feasible.

153.
Lonner, T.N. and R.J. Mackie. 1983. **On the nature of competition between big game and livestock.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 53-58.

Recent research findings indicate that competition for food, the basis for most evaluations of interspecific relationships between elk and cattle, may occur at a higher threshold and thus be less important than competition for space. Authors suggest that assessment of carrying capacity and management needs by forage allocation alone may be invalid on forest-range grazed by livestock and big game. Allocation of area may be more practical and ecologically sound than allocation of forage.

154.
Lyon, L.J. 1976. **Vegetal development on the Sleeping Child Burn in western Montana, 1961-1973.** U.S.D.A. Forest Service, Research Paper INT-184. 24 p.

Sixty-six percent of all cover on a lodgepole pine burn during the first postfire growing season was provided by seeded grasses and legumes, but by the 12th season introduced species only accounted for 17% of the total vascular plant cover. The author postulated that the seeded species were apparently unable to compete with native herbs and shrubs during the dry summers of western Montana.

155.
McClinton, J.F. 1983. **The use of woodland suitability groups in planning forestland grazing.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 109-114.

Author introduces the concept of "Woodland Suitability Groups", a tool used by the U.S.D.A. Soil Conservation Service to indicate different timber management alternatives on a particular ecological site. The usefulness of the concept is discussed in terms of forest-range management and determination of livestock carrying capacity.

156.
McClure, N.R. 1958. **Grass seedings on lodgepole pine burns in the northwest.** Journal of Range Management 11: 183-186.

Orchardgrass, smooth bromegrass, and tall oatgrass became readily established in field-scale grass seedings, and by the 2nd year provided excellent ground cover and considerable forage for livestock. The author suggests that seed source and climatic conditions are the primary factors influencing forest regeneration, with the competitive effect of perennial grass cover subordinate to, and modified by, these two major influences.

157.
McConnell, B.R. and J.G. Smith. 1965. **Understory response three years after thinning pine.** Journal of Range Management 18: 129-132.

Understory yield was greater on thinned than on unthinned plots. The success of pinegrass on thinned sites was attributed to a possible competitive advantage associated with its rhizomatous rooting habit.

158.
McConnell, B.R. and J.G. Smith. 1970. **Response of understory vegetation to ponderosa pine thinning in eastern Washington.** Journal of Range Management 23: 208-212.

Tree thinning caused highly significant increases in understory yields. Forbs were more productive than grasses where coverage of the pine canopy exceeded 45%, but grasses were superior producers below 45% crown cover. Shrubs were the least productive at all levels.

159.
MacDonald, M.A. 1952. **Pine needle abortion in range beef cattle.** Journal of Range Management 5: 150-155.

Author found that ingestion of ponderosa pine needles and buds increased the frequency of abortions and stillbirths in pregnant range cows.

160.
McEwen, L.C. and D.R. Dietz. 1965. **Shade effects on chemical composition of herbage in the Black Hills.** Journal of Range Management 18: 184-190.

Kentucky bluegrass, ricegrass, wildrye, timothy, and various sedges growing under forest cover were generally higher in protein, crude fibre, calcium, and phosphorus, but lower in nitrogen-free extract than similar plants from open meadows on the same soils. Although nutritionally adequate, the forest herbs were less palatable than unshaded forage.

161.
McIlvain, E.H. and M.C. Shoop. 1971. **Shade for improving cattle gains and rangeland use.** Journal of Range Management 24: 181-184.

Shade increased summer-long gains of yearling Hereford steers on open Oklahoma rangelands. By manipulating shade, managers were also able to draw cattle to under-utilized areas and reduce concentrated spot grazing.

162.
McIntosh, P.D. 1976. **British Columbia rangelands.** B.S.F. thesis, University of British Columbia, Vancouver. 65 p.

Author presents a brief history of ranching in British Columbia, a description of the interior rangelands, and a discussion of range management and administrative problems.

163.
McLean, A. 1967. **Beef production on lodgepole pine-pinegrass range in southern British Columbia.** Journal of Range Management 20: 214-216.

Yearling steers had an average daily gain of 0.80 kg. Average gain per hectare was 21.9 kg, and average stocking rate was 1.94 ha/AUM. Pinegrass provided over 50% of the forage yield and was readily accepted during early summer, but became unpalatable by mid-August.

164.
McLean, A. 1967. **Germination of forest range species from southern British Columbia.** Journal of Range Management 20(5): 321-322.

In laboratory trials, seed from 10 out of 25 forest-range herbs and shrubs germinated without scarification or stratification. Stratification was required for five species and improved the germination of 10 others. Seventeen species germinated at 1^{0} C after prolonged stratification; it was suggested that this characteristic would enable seedlings to become established ahead of domestic grasses seeded in the spring.

165.
McLean, A. 1969. **Fire resistance of forest species as influenced by root systems.** Journal of Range Management 22: 120-122.

A close relationship was found between root system characteristics and relative fire resistance of understory species in Douglas-fir forests. Susceptible species have rhizomes less than 5 cm below the mineral soil surface, and resistant species have rhizomes 5-13 cm below the mineral soil surface.

166.
McLean, A. 1970. **Plant communities of the Similkameen valley, British Columbia, and their relationships to soils.** Ecological Monographs 40: 403-424.

Five vegetation zones and 16 habitat types are described. The zones follow an elevational gradient from dry to moist: sagebrush, ponderosa pine, Douglas-fir, subalpine fir, and alpine.

167.
McLean, A. 1972. **Beef production on lodgepole pine - pinegrass range in the Cariboo Region of British Columbia.** Journal of Range Management 25: 10-11.

Yearling steers had an average daily gain of 0.79 kg. Average gain per hectare was 20.2 kg, and average carrying capacity was estimated to be 1.86 ha/AUM.

168.
McLean, A. 1972. **Cattle take part in multi-resource development.** Canada Agriculture 17(1): 6-9.

Experimental grazing management of cattle on Douglas-fir forest-range in British Columbia is described. Stocking rates were increased and efficient use was made of the available forage in these forest communities.

169.
McLean, A. 1979. **Grazing forests and clearcuts.** Western Wildlands 5(4): 34-35.

A brief discussion of forest grazing in the Pacific Northwest. Author points out that the key to making sound integrated resource management decisions is adequate fundamental knowledge.

170.
McLean, A. 1983. **Classification and management of the Douglas-fir-pinegrass region.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 15-18.

The management of livestock and vegetation on Douglas-fir forest-range in southern British Columbia is described.

171.
McLean, A. and A.H. Bawtree. 1971. **Seeding forest rangelands in British Columbia.** Canada Department of Agriculture, Ottawa. Publication No. 1463. 14 p.

Guidelines are provided concerning species selection, seedbed treatment, seeding time, and application rates for forage and erosion control seedings on southern forest-ranges.

172.
McLean, A. and M.B. Clark. 1980. **Grass, trees, and cattle on clearcut-logged areas.** Journal of Range Management 33: 213-217.

The presence of domestic grass had little effect on germination or survival of lodgepole pine and Engelmann spruce except where the grass became overly dense. Competition from native vegetation was of as much consequence as competition from domestic grasses. Animal damage was due to repeated trampling rather than browsing. However, the authors report that where numbers of cattle and period of grazing were adequately controlled, damage to conifer seedlings was negligible.

173.
McLean, A., M.B. Clark, D.E. Waldern and M.T. Wallace. 1978. **Grass, trees, or cattle.** Canada Agriculture 23(4): 24-26.

The results of studies carried out by Agriculture Canada and the B.C. Ministry of Forests are summarized. The authors conclude that where numbers of cattle and period of grazing are adequately controlled, damage to coniferous seedlings is negligible. Further, it was noted that the presence of domestic grass generally had little effect on germination or survival of conifers.

174.
McLean, A., S. Freyman, J.E. Miltmore and D.M. Bowden. 1969. **Evaluation of pinegrass as range forage.** Canadian Journal of Plant Science 49: 351-359.

Crude protein and digestibility decreased and lignin, fibre, and ash increased over the growing season. Pinegrass contained adequate nutrients for the rapid growth of yearlings and maintenance of weanling calves until August 1; protein and phosphorus supplementation were required after this date.

175.
McLean, A. and W.D. Holland. 1958. **Vegetation zones and their relationship to the soils and climate of the upper Columbia valley.** Canadian Journal of Plant Science 38: 328-345.

Three major vegetation zones are identified: Douglas-fir, cedar/hemlock, and spruce/fir. Precipitation appears to be the principal factor governing development of both vegetation and soils in the region.

176.
McLean, A., T.M. Lord and A.J. Green. 1970. **Utilization of the major plant communities in the Similkameen Valley, British Columbia.** Journal of Range Management 24: 346-351.

The main resource uses of plant communities in southern British Columbia are identified. Authors suggest that the ponderosa pine zone is best suited for grazing, the Douglas-fir zone for integrated use, and the subalpine fir zone for timber production.

177.
McLean, A., E.R. Smith and W.L. Pringle. 1964. **Handbook on grazing values of range plants of British Columbia.** Canada Department of Agriculture, Kamloops, B.C. 41 p.

Data are provided on the growth characteristics, geographical distribution, habitat, abundance, grazing preference, nutritive quality, and indicator value of important grassland and forest-range plants in British Columbia.

178.
McLean, A. and J.H.G. Smith. 1973. **Effects of climate on forage yields and tree-ring widths in British Columbia.** Journal of Range Management 26(6): 416-419.

Dry summer months were correlated with superior forage yields on forest-range, provided the past year had been wet. However, the relationship was not consistent. Further, there was no consistent relationship between tree diameter growth and climatic conditions.

179.
McLean, A. and E.W. Tisdale. 1960. **Chemical composition of native forage plants in British Columbia in relation to grazing practices.** Canadian Journal of Plant Science 40: 405-423.

Percentages of crude protein and phosphorus decreased while crude fibre increased from spring to fall on grassland and forest ranges. Grasses had higher percentages of crude fibre than forbs or current shrub growth. Nutritive level of range forage is reported to be satisfactory for livestock production, although winter supplementation of phosphorus may sometimes be necessary.

180.
McLean, A. and E.W. Tisdale. 1972. **Recovery rate of depleted range sites under protection from grazing.** Journal of Range Management 25(3): 178-181.

Little change in plant species composition occurred on ponderosa pine sites in poor range condition over the first decade following fencing. It took longer for the sites to progress from poor to fair condition than from fair to good condition.

181.
McLean, A. and T.G. Willis. 1961. **The range story of British Columbia.** Agricultural Institute Review 16(1): 19-22.

The history of ranching, range management, and range research in British Columbia is briefly described.

182.
McLean, A. and W. Willms. 1977. **Cattle diets and distribution on spring-fall and summer ranges near Kamloops, British Columbia.** Canadian Journal of Animal Science 57: 81-92.

Diet composition averaged 93% grass, 2% forbs, 2% shrubs, and 3% trees. Forb and tree consumption increased and shrub utilization decreased over the summer. In the fall, grass and shrub utilization increased, while forb and tree consumption decreased.

183.
McMinn, J.W. 1980. **Total-forest concept in multi-resource management.** Journal of Forestry 78: 208-210.

Author argues that management for multiple resources requires consideration of the entire forest rather than individual stands. It is pointed out that analysis of the interaction between rotation and stocking forestwide is necessary to identify management options for efficient production of conflicting benefits.

184.
McMurtrie, R. and L. Wolf. 1983. **A model of competition between trees and grass for radiation, water and nutrients.** Annals of Botany 52: 449-458.

A mathematical model is introduced, which explores conditions of co-existence for trees and grass. The model describes growth of both types of plants in terms of key physiological processes, and is used to analyze how species compete by depriving each other of resources essential for growth.

185.
Madany, M.H. and N.E. West. 1983. **Livestock grazing-fire regime interactions within montane forests of Zion National Park, Utah.** Ecology 64(4): 661-667.

The vegetation structure of grazed and ungrazed ponderosa pine communities is compared. Grazed sites had higher tree densities and lower herb cover than ungrazed sites. Authors suggest that competition for soil moisture and nutrients, as well as allelopathic inhibition, limited the number of pine seedlings establishing in ungrazed communities, with periodic fires playing a secondary role. Grass reduction by livestock grazing is believed to hasten the shift from savanna to forest conditions.

186.
Maduram, G.H. 1975. **Summary of range improvement experiments and trials in the forest areas of Alberta.** Alberta Energy and Natural Resources, Edmonton, Alberta. 39 p.

Author summarizes research conducted by Forest Service personnel on Alberta forest-ranges, and indicates the direction in which future range research projects should proceed.

187.
Majak, W., D.E. Waldern and A. McLean. 1977. **Pine needle water extracts as potential abortive agents in gestating cow diets.** Journal of Range Management 30(4): 318-319.

No pre-partum effects were observed in five pregnant cows after ingestion of ponderosa pine needle extract during their last trimester. Normal calves were delivered.

188.
Majak, W., R.J. Williams, A.L. van Ryswk and B.M. Brooke. 1976. **The effect of rainfall on Columbia milkvetch toxicity.** Journal of Range Management 29(4): 281-283.

On rough fescue grassland, increased rainfall extended toxicity intervals and increased miserotoxin levels. In contrast, toxicity trends on Douglas-fir forest-range were unrelated to variability in precipitation.

189.
Miller, R.F. and W.C. Krueger. 1976. **Cattle use on summer foothill rangelands in northeastern Oregon.** Journal of Range Management 29: 367-371.

Clearcuts seeded to forage were more productive than bunchgrass or forested ranges, and provided 63% of the forage consumed by cattle. Seeded grasses accounted for 55% of the cattle diet. Soil depth and canopy cover were related to understory production and utilization by cattle. Competition between cattle and big game for available forage was not observed.

190.
Miller, R.F., W.C. Krueger and M. Vavra. 1981. **Deer and elk use on foothill rangelands in northeastern Oregon.** Journal of Range Management 34(3): 201-294.

Bunchgrass and logged communities provided 90% of big game diets during spring and early summer. Diets were comprised of 52% grasses, 38% forbs, and 10% browse. Composition of plant species in the diets varied seasonally.

191.
Miller, T. 1975. **Cattle and trees thriving together.** New Zealand Journal of Agriculture 130(4): 4-5, 53-54.

A commercial venture in New Zealand involving the combined production of radiata pine and cattle is described. Although initial evaluations have been promising, the project has not yet been proven to be economically viable.

192.
Minore, D. and M.E. Dubrasich. 1981. **Regeneration after clearcutting in subalpine stands near Windigo Pass, Oregon.** Journal of Forestry 79: 619-621.

Clearcuts were adequately restocked 9-12 years after harvest with naturally regenerated mountain hemlock, western white pine, and lodgepole pine. Authors conclude that clearcutting generally appears to be an acceptable harvesting method in subalpine stands.

193.
Mitchell, J.E., D.M. Eissenstat and A.J. Irby. 1982. **Forest grazing - an opportunity for diplomacy.** Rangelands 4(4): 172-174.

Authors discuss problems associated with livestock grazing on private forestland and offer potential solutions. They conclude that more research is needed on grass/tree competition, animal damage, and the economic tradeoffs between timber and livestock production.

194.
Mitchell, J.E. and R.T. Rodgers. 1985. **Food habits and distribution of cattle on a forest and pasture range in northern Idaho.** Journal of Range Management 38(3): 214-220.

A large proportion of the diet on ponderosa pine/Douglas-fir forest-range was browse, even when the quantity and quality of herbaceous vegetation were not limiting. Authors conclude that range managers, when determining carrying capacity, should consider tall and mid-browse species as a source of forage for cattle.

195.
Mitchell, W.K. 1982. **The construction and rehabilitation of logging landings in the Cariboo Forest Region.** B.C. Ministry of Forests, Cariboo Forest Region, Research Brief No. 20. 30 p.

An assessment of landing construction, operations, slash disposal, and rehabilitation found: 1) a loss of nutrients due to removal of topsoil; 2) reduced compaction at the soil surface through scarification; 3) fair to good establishment of seeded grasses, particularly on scarified or burned sites; and 4) poor growth of planted spruce.

196.
Moir, W.H. 1966. **Influence of ponderosa pine on herbaceous vegetation.** Ecology 47(6): 1045-1048.

Pine stands in the sapling stage adversely modify the herbaceous environment. Increased light interception by pine canopies and poor soil nitrogen supply under trees lead to reduced inflorescence production of grasses, declining populations, and eventually total suppression of herbs.

197.
Monfore, J.D. 1983. **Livestock - a useful tool for vegetation control in ponderosa pine and lodgepole pine plantations.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 105-107.

By quantifying forage production, controlling the timing, placement, and numbers of livestock, and maintaining effective herd distribution, forest managers minimized damage on pine plantations. Further, grazing was found to control understory vegetation, reduce fire hazard, and increase potential growth gains to planted pines.

198.
Moore, A.W. 1940. **Wild animal damage to seed and seedlings on cut-over Douglas-fir lands of Oregon and Washington.** U.S.D.A. Technical Bulletin No. 706. 28 p.

The nature and extent of tree damage by small mammals and big game is discussed. Author points out that artificial reforestation appears to suffer more from animal attack than does natural regeneration.

199.
Moore, W.H., B.F. Swindel and W.S. Terry. 1982. **Vegetative response to clearcutting and chopping in a North Florida flatwoods forest.** Journal of Range Management 35(2): 214-218.

Clearcutting and chopping reduced woody understory cover and increased herbaceous species frequency and diversity. The collective vegetative response to mechanical site disturbance was qualitatively similar to response to fire, but more pronounced.

200.
Morris, M.S. 1947. **The grazing use of forest lands in the northern Rocky Mountain region.** Proceedings of the Society of American Foresters 1947: 303-311.

An early assessment of forest grazing in Idaho and Montana is presented. Author briefly describes the climate, soils, topography, and vegetation of the region, then discusses grazing practices affecting land use. The economics of forest grazing are also considered.

201.
Nagle, J.P. and G.A. Harris. 1966. **Grazing compatibility of cattle and elk on mountain ranges.** Proceedings of the International Grassland Congress 10: 994-997.

Competition for forage may become intense if populations of either species are allowed to increase disproportionately. Authors discuss management practices and research to increase total production from common use.

202.
Noble, D.L. 1979. **Roots of lodgepole pine seedlings reach depth of only 3 to 4 inches their first season.** U.S.D.A. Forest Service, Research Note RM-363. 3 p.

Lodgepole pine seedlings on scarified, unshaded seedbeds had an average rooting depth of 9.6 cm, 26 branch roots, and a total root length of 24.9 cm after 1 year's growth.

203.
Noble, D.L. and R.R. Alexander. 1977. **Environmental factors affecting natural regeneration of Engelmann spruce in the central Rocky Mountains.** Forest Science 23(4): 420-429.

Natural regeneration success of Engelmann spruce on clearcuts is controlled by weather and aspect, and modified by seedbed conditions. Establishment is best on shaded, mineral soil.

204.
Noble, D.L., C.B. Edminster and W.D. Shepperd. 1979. **Effects of watering treatments on germination, survival and growth of ponderosa pine: a greenhouse study.** U.S.D.A. Forest Service, Research Note RM-369. 6 p.

Amount and distribution of water affected germination, survival and growth of seedlings. Performance was best when seedlings received 2.5 cm or more of water evenly distributed over the growing period.

205.
Noble, D.L. and F. Ronco, Jr. 1978. **Seedfall and establishment of Engelmann spruce and subalpine fir in clearcut openings in Colorado.** U.S.D.A. Forest Service, Research Paper RM-200. 12 p.

Seed production, dispersal into clearcut openings, and seedling survival were measured. Data indicated that seedbed conditions and other environmental factors, rather than seed availability, controlled regeneration success. Stocking appeared dependent on size of openings. Authors state that seedlings surviving to 4 years of age had a good chance of permanent establishment.

206.
Nordstrom, L.O. 1985. **The ecology and management of forest-range in British Columbia: a review and analysis.** B.C. Ministry of Forests, Land Management Report No. 19. 104 p.

The literature on forest grazing throughout North America is synthesized, and the applicability of results from geographically widespread studies to the situation in British Columbia assessed. Research needs are identified.

207.
Norris, L.A. 1977. **Arsenic in cattle hair after forests are precommercially thinned with organic arsenical herbicides.** U.S.D.A. Forest Service, Research Note PNW-296. 8 p.

Arsenic levels in cattle hair increased over the grazing season on forest-range treated with the silvicides monosodium methanearsonate and cacodylic acid. Concentrations were within normal ranges, however, indicating proper use of the chemicals.

208.
O'Brian, R. and D.D. Van Hooser. 1983. **Understory vegetation inventory: an efficient procedure.** U.S.D.A. Forest Service, Research Paper INT-323. 6 p.

A procedure is described for surveying understory vegetation that can be used in combination with other information to evaluate wildlife habitat, forage, and grazing potential.

209.
O'Connell, M.W. 1983. **Forestland grazing on Boise Cascade owned lands in northeast Washington.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 97-99.

Unrestricted grazing by livestock in the early stages of stand regeneration may cause considerable damage to, or prevent establishment of, a new forest. The author indicates that Boise Cascade has sought to control grazing on its lands by restricting livestock to stands 15 years of age or older.

210.
Orr, H.K. 1970. **Runoff and erosion control by seeded and native vegetation on a forest burn: Black Hills, South Dakota.** U.S.D.A. Forest Service, Research Paper RM-60. 12 p.

Development of seeded and native vegetation following wildfire in a ponderosa pine forest is described. Minimum soil stability would not have been achieved by the fourth growing season without artificial seeding of grasses and legumes.

211.
Oswald, B.P. and W.W. Covington. 1983. **Changes in understory production following a wildfire in southwestern ponderosa pine.** Journal of Range Management 36: 507-509.

Two years after a wildfire, herbage and forage production were approximately three times greater than unburned control sites.

212.
Pase, C.P. 1958. **Herbage production and composition under immature ponderosa pine stands in the Black Hills.** Journal of Range Management 11: 238-243.

Inverse logarithmic relationships were found between total herbage production and ponderosa pine canopy cover, basal area, and litter accumulations. Production of Kentucky bluegrass, little bluestem, prairie dropseed, and fuzzyspike wildrye declined as pine crown cover increased; roughleaf ricegrass and sedges decreased in total biomass but increased in relative importance. Few of the forbs persisted under even moderately dense canopies.

213.
Pase, C.P. and R.M. Hurd. 1958. **Understory vegetation as related to basal area, crown cover and litter produced by immature ponderosa pine stands in the Black Hills.** Proceedings of the Society of American Foresters 1958: 156-158.

Production of grasses, forbs, and shrubs all increased as pine litter, basal area, and crown density decreased. Composition of the herbaceous understory changed as basal area increased, with shade-tolerant species assuming greater importance.

214.
Patton, D.R. 1976. **Timber harvesting increases deer and elk use of a mixed conifer forest.** U.S.D.A. Forest Service, Research Note RM-329. 3 p.

Increased forage production following timber harvest was noted to stimulate big game use.

215.
Pearson, H.A. 1972. **Estimating cattle gains from consumption of digestible forage on ponderosa pine range.** Journal of Range Management 25(1): 18-20.

Beef gain was directly related to in vitro digestible forage, thus providing a useful method for predicting beef production from studies in which forage is measured but beef gains are not.

216.
Pearson, H.A. 1973. **Calculating grazing intensity for maximum profit on ponderosa pine range in northern Arizona.** Journal of Range Management 26(4): 277-278.

A profit formula based on (1) forage production, digestibility and utilization, (2) animal weight and daily gain, (3) costs per animal day, and (4) beef prices is introduced and discussed.

217.
Pearson, H.A. 1974. **Utilization of a forest grassland in southern United States.** Proceedings of the International Grasslands Congress 12: 409-415.

Light and moderate grazing did not affect survival of planted or seeded slash pines, but heavy grazing resulted in 20% fewer trees on planted sites. Grazing intensity and tree growth did not appreciably influence the amount of herbage produced until the stand was 9 years old. Tree density caused herbage yields to decline after this point regardless of grazing intensity. Utilization was higher on burned than unburned forest-range.

218.
Pearson, H.A., J.R. Davis and G.H. Schubert. 1972. **Effects of wildfire on timber and forage production in Arizona.** Journal of Range Management 25: 250-253.

Radial growth increased on burned ponderosa pine where crown kill was less than 60%, and decreased where crown kill was more than 60%. Fire initially stimulated growth of herbaceous vegetation and temporarily enhanced herbage nutrient value. Artificially seeded areas produced the most forage.

219.
Pearson, H.A. and D.A. Jameson. 1967. **Relationship between timber and cattle production on ponderosa pine range: The Wild Bill Range.** U.S.D.A. Forest Service, Rocky Mountain Forest and Range Experiment Station, Colorado State University, Fort Collins. 10 p.

The climate, vegetation, silvicultural treatments, range management practices, and research activities in a ponderosa pine forest in Arizona are described.

220.
Pearson, H.A. and H.S. Sternitzke. 1974. **Forest-range inventory: a multiple-use survey.** Journal of Range Management 27(5): 404-407.

Authors report successful attempts to incorporate understory herbage and browse measurements into a nationwide forest survey. The objective was to inventory timber, range, and wildlife habitat resources on a regular basis requiring minimum time and environmental disturbance.

221.
Pearson, H.A. and L.B. Whitaker. 1973. **Returns from southern forest grazing.** Journal of Range Management 26(2): 85-87.

Data are provided on the economics of grazing cattle on slash pine/bluestem forest-range in central Louisiana. Excluding labour costs, per-cow returns on the investment were best with light stocking. Net returns per hectare were highest at the heaviest stocking rate.

222.
Pearson, H.A. and L.B. Whitaker. 1974. **Yearlong grazing of slash pine ranges: effects on herbage and browse.** Journal of Range Management 27: 195-197.

Total herbage yields under immature pine were not significantly altered by year-long cattle grazing, which removed 30-60% of the annual growth. However, moderate (45%) and heavy (60%) grazing changed herbage composition. Individual browse species were not affected by grazing intensity, but total cover was decreased with moderate grazing. As tree density increased, total herbage yields were reduced.

223.
Pearson, H.A., L.B. Whitaker and V.L. Duvall. 1971. **Slash pine regeneration under regulated grazing.** Journal of Forestry 69: 744-746.

Neither light nor moderate grazing by cattle affected establishment and survival to age 5 years of planted or seeded pine. Heavy grazing of plantings resulted in 20% fewer trees than the ungrazed control, but the losses were evenly distributed. Survival of seeded stands was unaffected by heavy utilization. Grazing had no discernible effect on height growth.

224.
Peek, J.M., F.D. Johnson and N.N. Pence. 1978. **Successional trends in a ponderosa pine/bitterbrush community related to grazing by livestock, wildlife, and fire.** Journal of Range Management 31(1): 49-53.

A combination of periodic natural fires and livestock grazing were probably initially responsible for the secondary successional vegetation on the study site. Authors believe that subsequent utilization of the seral vegetation by big game retarded succession to climax.

225.
Pettit, R.D. 1968. **Effects of seeding and grazing on a clearcut-burn in a mixed-coniferous forest stand of the Wallowa Mountain foothills.** Ph.D. thesis, Oregon State University, Corvallis.

Author investigated early plant succession, big game use, environmental relationships, and the influence of livestock grazing on native and introduced species in a burned clearcut in Oregon.

226.
Pickford, G.D. and E.R. Jackman. 1944. **Reseeding eastern Oregon summer ranges.** Oregon State College, Corvallis. Agricultural Experiment Station, Circular No. 159. 48 p.

Guidelines are presented for seeding grasses and legumes on burned lodgepole pine ranges. Adapted grass species include timothy, orchardgrass, Kentucky bluegrass, alta fescue, meadow fescue, Chewings fescue, highland bentgrass, smooth bromegrass, and slender wheatgrass. The one legume tested, white clover, failed to establish.

227.
Pimental, D., P.A. Oltenacu, M.C. Nesheim, J. Krummel, M.S. Allen and S. Chick. 1980. **The potential for grass fed livestock: resource constraints.** Science 207: 843-848.

Using pasture and grazed forest-range to produce livestock through grass feeding alone reduces the inputs of energy about 60% and land resources about 8%, but also reduces the production of animal protein in the United States by half.

228.
Pitt, M.D. 1982. **East Kootenay problem analysis: the interactions among grass, trees, elk and cattle.** B.C. Ministry of Forests, Research Branch, Victoria. 65 p.

Conflicts among livestock, wildlife, and timber interests in the southern Rocky Mountain Trench of British Columbia are reviewed, and specific research programs proposed. Author concludes that most of the current controversies stem from philosophical and technical disagreements over the proper allocation and utilization of a forage resource which is gradually shrinking due to forest ingrowth and succession.

229.
Pitt, M.D. 1984. **Range condition and trend assessment in British Columbia.** B.C. Ministry of Forests, Research Report RR84004-HQ. 117 p.

A critical review of literature on range condition and trend in North America is presented. Author indicates that range condition classification of forest-range in British Columbia must distinguish between the separate influences of natural forest succession and vegetation changes produced by grazing animals. He further points out that range condition and associated resource value ratings may be determined for any seral stage, including areas recovering from clearcut logging.

230.
Pumphrey, F.V. 1971. **Grass species growth on a volcanic ash-derived soil cleared of forest.** Journal of Range Management 24: 200-203.

Grasses producing high forage yields on clearcut ponderosa pine/ Douglas-fir/grand fir forest-range in northeast Oregon were intermediate wheatgrass, big bluegrass, and smooth brome. Tall oatgrass and meadow foxtail were high yielding when fertilized. Fertilized forage contained slightly lower nitrogen concentrations than non-fertilized forage due to a disproportionate increase in biomass production.

231.
Pyke, D.A. and B.A. Zamora. 1982. **Relationships between overstory structure and understory production in the grand fir/myrtle boxwood habitat type of northcentral Idaho.** Journal of Range Management 35: 769-773.

Overstory characteristics measured were tree canopy cover, sum of tree diameters, basal area, stand height, and stem density. Canopy coverage and sum of tree diameters were correlated with forb and shrub production. Graminoid production was not statistically related to any of the measured overstory parameters. The derived models are not applicable to areas where logging, fire, or disease has recently altered overstory structure.

232.
Quinton, D.A. 1984. **Cattle diets on seeded clearcut areas in central interior British Columbia.** Journal of Range Management 37(4): 349-352.

Grass, forbs, and shrubs accounted for 58.5, 33.5, and 9% of the diets, respectively. Orchardgrass, timothy, smooth brome, horsetail, lupine, aster, and willow were the major forest species consumed. Forb use increased during dry years.

233.
Radwan, M.A. 1972. **Differences between Douglas-fir genotypes in relation to browsing preference by black-tailed deer.** Canadian Journal of Forest Research 2: 250-255.

Genotypes resistant to deer browsing had lower dry matter and cellulose digestibilities; essential oils with greater inhibitory action on rumen microbial activity; higher content of fats, total phenols, flavanols, and leucoanthocyanins; and lower levels of chlorogenic acid.

234.
Regelin, W.L. and O.C. Wallmo. 1978. **Duration of deer forage benefits after clearcut logging of subalpine forest in Colorado.** U.S.D.A. Forest Service, Research Note RM-356. 4 p.

Measurement of forage production and deer use after clearcut logging indicated an initial negative habitat influence, followed by benefits that peak before 15 years but persist beyond 20 years.

235.
Regelin, W.L., O.C. Wallmo, J. Nagy and D.R. Dietz. 1974. **Effect of logging on forage values for deer in Colorado.** Journal of Forestry 27(5): 282-285.

Crude protein content, moisture content, and in vitro digestibility within a collection date did not differ statistically between clearcut and uncut strips. Deer spent more time on clearcuts because of greater species diversity and plant productivity, and obtained most of their crude protein and digestible dry matter from these sites.

236.
Reid, E.H. 1947. **Forest grazing in the Pacific Northwest.** Proceedings of the Society of American Foresters 1947: 296-303.

Author distinguishes between grazing east and west of the Cascade Range in Washington and Oregon. Land east of the Cascades is more suited to range use, with ponderosa pine dominating forest-range. The author suggested that well managed grazing was unlikely to have a detrimental effect on pine reproduction, although little information on the subject was available at the time.

237.
Reid, E.H. 1965. **Forage production in ponderosa pine forests.** Proceedings of the Society of American Foresters 1965: 61-64.

The forage values of commercial ponderosa pine forests for livestock and wildlife are discussed, with special reference to the influences of overstory, silviculture, and grass seeding. The author concludes that attention to the problems of multiple use management is imperative for the combined production of trees, livestock, and wildlife.

238.
Reid, Collins Nurseries Ltd. 1983. **The management and silviculture of lodgepole pine in B.C.: an interpretive review.** Forest Research Council of British Columbia, Occasional Paper No. 1. 64 p.

A comprehensive analysis of lodgepole pine management, including site preparation, artificial and natural regeneration, juvenile spacing techniques, growth and yield, damaging agents, economics, fertilization, genetic improvement, and multiple resource management.

239.
Reynolds, H.G. 1966. **Slash cleanup in a ponderosa pine forest affects use by deer and cattle.** U.S.D.A. Forest Service, Research Note RM-64. 3 p.

Slash clearing had no measurable effect on total amount or composition of understory vegetation on the study site. Cattle droppings were most numerous on areas cleared of slash, but deer pellet groups were more abundant where slash was undisturbed.

240.
Richmond, R.M. 1983. **Problems and opportunities of forestland grazing in the Pacific Northwest.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 71-73.

Optimism is expressed concerning opportunities for increased sheep grazing in U.S. National Forests. However, the author has reservations about increased cattle grazing because of the problems associated with timber harvest, timber regeneration, increased big game use, and the need for improved management of riparian vegetation.

241.
Rietveld, W.J. 1975. **Phytotoxic grass residues reduce germination and initial root growth of ponderosa pine.** U.S.D.A. Forest Service, Research Paper RM-153. 15 p.

Author reports that a growth-inhibiting substance is produced in live foliage and litter of Arizona fescue and mountain muhly, which reduces total germination, rate of germination, and initial radicle development of ponderosa pine.

242.
Rindt, C.A. 1965. **A silviculturist looks at grass and grazing effects on ponderosa pine.** Proceedings of the Society of American Foresters 1965: 69-70.

Author states that grass principally affects ponderosa pine regeneration by competing for soil moisture. It is noted that decisions regarding the amount of grass that can be tolerated on a pine regeneration area and the reforestation of sites subject to grazing use should be based on factual, scientifically derived information about competitive interactions and animal damage.

243.
Riney, T. 1966. **Improvement of range management on forestland.** Proceedings of the International Grasslands Congress 10: 813-817.

Trends toward more intensive management of the most productive areas, coupled with a decrease in exploitative pressures on less productive sites, have been growing in the livestock and timber industries. Author suggests that multiple use of forestland is best suited to "ecologically marginal" sites.

244.
Roath, L.R. and W.C. Krueger. 1982. **Cattle grazing and behaviour on a forested range.** Journal of Range Management 35(3): 332-338.

Distinct home range groups of cattle were identified through examination of patterns of forage use, cattle distribution, herd social structure, and cattle activities. Water and vegetation type were important parameters in determining area and degree of use. Time after sunrise and relative humidity were key factors in determining kind and timing of cattle activity.

245.
Roche, B.F., Jr. and D.M. Baumgartner (editors). 1983. **Forestland grazing.** Proceedings of a symposium held February 23-25, 1983. Washington State University, Pullman. 114 p.

A collection of papers on timber/forage/animal interrelationships in the Pacific Northwest. Objectives of the symposium were to: 1) provide a forum on forestland grazing; 2) offer a program pertinent to both range and forestry interests; and 3) initiate discussion between range and forestry groups.

246.
Ross, B.A. 1977. **Compatibility of cattle grazing with timber production on British Columbia's interior rangelands.** B.S.F. thesis, University of British Columbia, Vancouver. 43 p.

Literature is reviewed on forest grazing in British Columbia, with emphasis on overstory/understory relationships, grass-conifer competition, livestock damage to coniferous regeneration, forest-range seeding and fertilization, and grazing management. The author concludes that grazing and timber production can be complementary through proper management.

247.
Roy, D.F. 1953. **Effects of ground cover and class of planting stock on survival of transplants in the eastside pine type of California.** U.S.D.A. Forest Service, California Forest and Range Experiment Station, Research Note 87. 6 p.

Survival of planted ponderosa pine was best on bare soil. The author suggests that competing vegetation depleted soil moisture and stones reduced the moisture-holding capacity of the soil.

248.
Rummell, R.S. 1951. **Some effects of livestock grazing on ponderosa pine forest in central Washington.** Ecology 32: 594-607.

Tree regeneration in grazed and ungrazed pine stands is compared. Dense herbaceous vegetation inhibited advance tree reproduction on ungrazed sites. Increased pine regeneration in grazed stands was attributed to heavy grazing of the understory, rather than to exclusion of fire.

249.
Sage, R.W., Jr. and W.C. Tierson. 1975. **Establishing vegetative cover along logging access roads: techniques - costs - benefits.** Northern Logger 24(4): 16-17, 33-34, 38.

Authors describe the seeding of grasses and legumes on logging roads in New York state. Topics addressed include site preparation, fertilization, species mixes, costs, and benefits.

250.
Sassaman, R.W. 1972. **Economic returns from planting forage in national forests.** Journal of Forestry 70(8): 487-488.

A procedure is presented for estimating returns based on planting costs, forage values, and growth data.

251.
Schenk, D.E. 1974. **Trials for range improvement in the Grand Prairie forest.** Alberta Energy and Natural Resources, Range Improvement Technical Note No. 4. 14 p.

Author reports that the seeding of domestic grasses and legumes in this forest region requires adequate seedbed preparation for successful germination and establishment.

252.
Schimke, H.E., L.R. Green and D. Heavilin. 1970. **Perennial grasses reduce woody plant seedlings - on mixed conifer fuel break.** U.S.D.A. Forest Service, Research Note PSW-203. 3 p.

Seeded perennial grasses were found to reduce the number and height of woody plant seedlings as well as the amount of annual herb ground cover. Unseeded control plots were dominated by naturally regenerated ponderosa pine and native shrubs.

253.
Schlatterer, E.F. 1983. **Forest ecosystem classification and interpretation for management of forestland grazing and multiple uses.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 3-6.

Direction in ecosystem classification by the U.S. Forest Service encourages integrated taxonomies of soil and vegetation, but accommodates non-integrated approaches. A broadened definition of range condition has been incorporated into Forest Service management, and includes ecological status relative to potential natural community, as well as resource values for a variety of users.

254.
Severson, K.E. and C.E. Boldt. 1977. **Options for Black Hills forest owners: timber, forage, or both.** Rangeman's Journal 4:13-15.

Authors argue that regulation of tree stocking in ponderosa pine stands by periodic thinning promotes mixed crops of timber and forage which together are substantially more productive than either type of vegetation growing alone.

255.
Shepperd, W.D. and D.L. Noble. 1976. **Germination, survival and growth of lodgepole pine under simulated precipitation regimes: a greenhouse study.** U.S.D.A. Forest Service, Research Note RM-328. 4 p.

Germination increased with increasing amounts of water, but did not appear affected by even distribution of water during the month in contrast to one monthly application. Survival was acceptable when seedlings received 2.5 cm or more of water distributed throughout the month, though overall growth was better with 5 cm of water per month.

256.
Sims, H.P. and D. Mueller-Dombois. 1968. **Effect of grass competition and depth to water table on height growth of coniferous tree seedlings.** Ecology 49: 597-603.

The authors quantify the relationships among site productivity, soil moisture, and interspecific competition. At optimum depth to the water table on loamy sand, grass grew vigorously and suppressed growth of tree seedlings. On the less productive sandy soils, conifer seedlings were relatively unaffected by grass competition.

257.
Skovlin, J.M. 1957. **Range riding - the key to range management.** Journal of Range Management 10(6): 269-271.

The activities and importance of range riders in managing livestock distribution on ponderosa pine range in eastern Oregon is described.

258.
Skovlin, J.M. 1965. **Improving cattle distribution on western mountain rangeland.** U.S.D.A. Farmer's Bulletin No. 2212. 14 p.

Guidelines are provided for controlling cattle distribution and forage utilization on forested and open rangelands.

259.
Skovlin, J.M. and R.W. Harris. 1970. **Management of conifer woodland grazing resources for cattle, deer and elk.** Proceedings of the International Grasslands Congress 10: 75-78.

Utilization of ponderosa pine range was improved by a deferred-rotation grazing system. Elk use decreased as cattle stocking rate increased.

260.
Smith, H.B. 1968. **Managing grazing resources for profit on commercial timberlands.** Journal of Range Management 21(2): 114-118.

Author emphasizes that grazing plays a minor role as a source of revenue on commercial timberlands, and is therefore subordinate to the management and harvesting of timber. The author further points out that the grazing lease is an expression of the timberland owner's policy and is an important tool in management of the grazing resource.

261.
Squire, R.O. 1977. **Interacting effects of grass competition, fertilizing and cultivation on the early growth of Pinus radiata D. Don.** Australian Forest Research 7: 247-252.

Grass competition for soil moisture restricted growth and limited the ability of planted radiata pine to respond to favourable nutritional and physical soil conditions in northeastern Victoria, Australia.

262.
Stahelin, R. 1943. **Factors influencing the natural restocking of high altitude burns by coniferous trees in the central Rocky Mountains.** Ecology 24: 19-30.

The sudden destruction of climax Engelmann spruce and subalpine fir by fire in Colorado and Wyoming gives rise to a subclimax of aspen and lodgepole pine. Above the distribution of the latter two species, a dense turf of sedges and bluegrass forms on burned-over areas, constituting a barrier to establishment of tree seedlings. Author recommends that grassy areas with less than 10 seed trees per acre should be planted to re-establish a coniferous cover of spruce and fir.

263.
Stark, N. 1980. **Light burning and the nutrient value of forage.** U.S.D.A. Forest Service, Research Note INT-280. 7 p.

Light slash burning in a Douglas-fir clearcut did not increase nutrient value of herb and shrub foliage. Author concludes that low temperature burns are not suitable for improving the quality and quantity of browse.

264.
Sternitzke, H.S. 1976. **Grazing potential of Louisiana pine forest-ranges.** U.S.D.A. Forest Service, Research Note SO-203. 2 p.

The forage production potential of longleaf/slash pine and loblolly/shortleaf pine forest-ranges in Louisiana is evaluated.

265.
Storch, R.L. 1983. **The integration of the riparian zone in the grazing management of associated rangelands.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 19-21.

Author describes the problems and legislation associated with livestock grazing on riparian areas in forests of Idaho and Oregon.

266.
Stout, D.G. and B. M. Brooke. 1985. **Rhizomes and roots below clipped pinegrass tillers have a higher percent carbohydrate when attached to other nonclipped tillers.** Journal of Range Management 38: 276-277.

When rhizome connections were left intact between plants, surrounding nonclipped tillers apparently translocated carbohydrates to the roots of clipped tillers within a sod. Authors suggest that ungrazed or lightly grazed tillers should therefore play an important role in maintaining the overall vigour of a pinegrass stand.

267.
Stout, D.G., A. McLean, B. M. Brooke and J. Hall. 1980. **Influence of simulated grazing (clipping) on pinegrass growth.** Journal of Range Management 33(4): 286-291.

Decreased plant vigour due to herbage removal was found to depend on (1) the degree and time of herbage removal, and (2) either the environmental conditions during the year of clipping or the plant history before herbage removal or both. The authors recommend that pinegrass should be grazed for a short time while it is actively growing and later when mid-summer dormancy is well established to maintain its vigor.

268.
Strang, R.M. and J.V. Parminter. 1980. **Conifer encroachment on the Chilcotin grasslands of British Columbia.** Forestry Chronicle 56(1): 13-18.

Authors conclude that a combination of fire, grass competition, and micro-site determinants of soil moisture availability appear to be the main factors influencing encroachment of Douglas-fir and lodgepole pine onto grassland ranges.

269.
Strickler, G.S. and P.J. Edgerton. 1976. **Emergent seedlings from coniferous litter and soil in eastern Oregon.** Ecology 57: 801-807.

In greenhouse trials, the authors found that 66% of all seedlings emerged from litter, and 83% of these were species producing abundant windborne seed. They point out that scarification and seeding of logged areas with grass may prevent the establishment of desirable, as well as undesirable, native species.

270.
Strothman, R.O. 1972. **Douglas-fir in northern California: effects of shade on germination, survival and growth.** U.S.D.A. Forest Service, Research Paper PSW-84. 10 p.

More Douglas-fir seeds germinated and established under 50% shade than at 25 or 75% levels. Shade did not significantly improve survival of planted stock, and subsequent growth of both seeded and planted conifers was consistently associated with higher light intensities.

271.
Stuth, J.W. 1975. **Livestock, deer and logging interactions in the lodgepole pine - pumice region of central Oregon.** Ph.D. thesis, Oregon State University, Corvallis.

Deer diets were dominated by forbs, while cattle and sheep grazed predominantly on graminoids. Bitterbrush was used extensively by all three species. Herbaceous and shrub production was highest in logged areas, though 40-50% of the bitterbrush plants were lost during the harvesting operations.

272.
Sullivan, T.P. and D.S. Sullivan. 1982. **Barking damage by snowshoe hares and red squirrels in lodgepole pine stands in central British Columbia.** Canadian Journal of Forest Research 12: 443-448.

Snowshoe hares and red squirrels were found to damage approximately 30 and 38%, respectively, of potential crop trees. The authors conclude that both species may have a serious impact on lodgepole pine stocking control programs.

273.
Sullivan, T.P. and D.S. Sullivan. 1984. **Influence of range seeding on rodent populations in the interior of British Columbia.** Journal of Range Management 37(2): 163-165.

Populations of deer mice and voles increased on cutover forestland following experimental seeding of forage grasses and legumes. The authors suggest that failure of forage establishment may be partly attributed to seed predation by granivorous rodents.

274.
Tarrant, R.F. 1956. **Effects of slash burning on some physical soil properties.** Forest Science 2(1): 18-22.

Severe burning reduced macroscopic pore space and soil percolation rates. However, the overall influence of slash burning on soil moisture properties was of minor consequence.

275.
Thill, R.E. 1983. **Deer and cattle forage selection on Louisiana pine-hardwood sites.** U.S.D.A. Forest Service, Research Paper SO-196. 35 p.

Deer diets in forests and clearcuts were dominated by leafy browse throughout the year. Cattle diets in forests consisted mainly of grasses during summer and autumn, and a mixture of grasses and browse in winter and spring; diets in clearcut areas were dominated throughout the year by grasses and forbs.

276.
Thomas, J.W. 1983. **Forestland grazing - one part of a bigger picture.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 23-26.

The legal, economic, social, and ecological considerations involved in land-use planning and resource allocation are discussed. Author advocates a holistic approach to intensive natural resource management.

277.
Thompson, T.K. 1974. **Adaptive trial with arctic fescue at High Level, Alberta.** Alberta Energy and Natural Resources, Range Improvement Technical Note No. 5. 6 p.

Arctic fescue (Festuca altaica Trin.) established successfully on disturbed forestland in north central Alberta. The grass is recommended for erosion control and forage production in this region.

278.
Thompson, W.W. and F.R. Gartner. 1971. **Native forage response to clearing low quality ponderosa pine.** Journal of Range Management 24: 272-277.

Removal of the overstory resulted in increased forage production on forest-range in South Dakota. Warm season grasses were noted to respond more to clearing than did cool season grasses.

279.
Tiedemann, A.R. and G.O. Klock. 1973. **First-year vegetation after fire, reseeding, and fertilization on the Entiat Experimental Forest.** U.S.D.A. Forest Service, Research Note PNW-195. 23 p.

Erosion control seeding of orchardgrass, hard fescue, and timothy increased 1st-year vegetative cover by up to one-third. Perennial rye and yellow sweetclover showed poor development. Fertilization apparently improved plant vigour, but not total cover.

280.
Tisdale, E.W. 1950. **Grazing of forest lands in interior British Columbia.** Journal of Forestry 48(12): 856-860.

The main forest types used for livestock grazing in British Columbia are described. The author points out that the future of forest grazing is complicated by fire protection policies since the best ranges are under fire sub-climax forest stands.

281.
Tisdale, E.W. and A. McLean. 1957. **The Douglas-fir zone of southern British Columbia.** Ecological Monographs 27: 247-266.

Plant communities, associations, and associes of the Douglas-fir zone are classified. The authors indicate the need for (1) long-term studies of the effects of logging, grazing, and fire on forest succession, and (2) autecological studies of native species.

282.
Tisdale, E.W., A. McLean and S.E. Clarke. 1954. **Range resources and their management in British Columbia.** Journal of Range Management 7(1): 3-9.

Authors identify the vegetation types utilized for livestock grazing in British Columbia. Generally, grassland ranges supply spring-fall and winter grazing, while forests are used as summer range. The problems and opportunities of range livestock production in British Columbia are discussed.

283.
Tucker, R.E., W. Majak, P.D. Parkinson and A. McLean. 1976. **Palatability of Douglas-fir foliage to mule deer in relation to chemical and spatial factors.** Journal of Range Management 29(6): 486-489.

Relative preference was found to be positively correlated with site exposure, tree age, leaf height, and chlorogenic acid.

284.
Vale, T.R. 1981. **Tree invasion of montane meadows in Oregon.** American Midland Naturalist 105(1): 61-69.

Invasion of mountain hemlock, western white pine, grand fir, Douglas-fir, and lodgepole pine was related to cessation of sheep grazing, the absence of frequent fires, and cool moist weather. Cattle grazing did not prevent conifer encroachment.

285.
Vavra, M. 1983. **Managing grazing animal response to forestland vegetation.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 43-51.

Yearling heifer gains on forest pastures were found to exceed those on adjacent grassland during mid and late summer. Precommercial thinning of lodgepole pine and grass seeding of logged mixed conifer stands increased potential production per hectare.

286.
Volland, L.A. 1975. **Plant ecology as a land management tool.** In Range: multiple use management. B. Roche, Jr. (editor). Washington State University, Pullman, pp. 9-18.

An ecological approach to land management problems is proposed, based on description and classification of the biotic community, prediction of interrelationships among the biotic components, and prescription of appropriate treatments.

287.
Wallace, T. 1983. **Forage producing potentials in clearcut lodgepole pine types.** In Forestland grazing. B.F. Roche, Jr. and D.M. Baumgartner (editors). Washington State University, Pullman, pp. 75-78.

The grass seeding program of the B.C. Ministry of Forests, Kamloops Region, is described. Author believes that grass sowing and livestock grazing are compatible with, and under certain circumstances can enhance, growing conditions for trees.

288.
Watkins, J.M. 1940. **The growth habits and chemical composition of bromegrass, Bromus inermis Leyss, as affected by different environmental conditions.** Journal of the American Society of Agronomy 32: 527-538.

Shade decreased the number of shoots, rhizomes, and fertile shoots, dry weight of plant parts, and carbohydrate levels. Number of elongated internodes, plant height, and nitrogen content were increased.

289.
Watts, S. (editor). 1983. **Range management.** In Forestry Handbook, 4th edition. Forestry Undergraduate Society, Faculty of Forestry, University of British Columbia, Vancouver, pp. 73-84.

An overview of range types and range management in British Columbia is presented.

290.
White, L.D. 1977. **Forage production in a five-year-old fertilized slash pine (*Pinus elliottii*) plantation.** Journal of Range Management 30: 131-134.

Five years after fertilization total understory production was not different from control plots. However, species composition changed from dominance of unpalatable pineland threeawn to desirable bluestem species.

291.
Wikeem, B.M. and R.M. Strang. 1983. **Prescribed burning on British Columbia rangelands: the state of the art.** Journal of Range Management 36: 3-8.

Research and experience in the use of fire as a range management tool is reviewed. Authors outline a research program which will provide the necessary information to achieve specific range management goals in British Columbia through prescribed burning.

292.
Willms, W., A. McLean, R. Ritcey and D.J. Low. 1975. **The diets of cattle and deer on rangeland.** Canada Agriculture 20(4): 21-23.

Studies of diet overlap on mule deer winter range showed that competition was minimal when cattle grazing was kept at recommended levels. Competition was greatest in late winter and early spring when deer depend largely on new grass or fall regrowth to replace lost body weight and provide nourishment for fetal growth.

293.
Willms, W., A. McLean, R. Tucker and R. Ritcey. 1980. **Deer and cattle diets on summer range in British Columbia.** Journal of Range Management 33: 55-59.

When the availability of preferred forage was not limiting, dietary overlap between mule deer and cattle was high. However, as forage availability declined, similarities in diet decreased as both deer and cattle were forced into their individual food niches: grass for cattle and shrubs for deer.

294.
Wilson, T.I. 1949. **Out of the ashes come the grasses.** Soil Conservation 15: 36-39.

Author describes the initial establishment of artificially seeded grass/legume mixes on burned ponderosa pine forestland in Oregon, and documents population changes over a 9 year period. Tall oatgrass and smooth bromegrass were the most successful of the grasses sown, but none of legumes did particularly well.

295.
Winston, D.A. 1974. **Urea fertilizer toxic to young jack pine seedlings.** Tree Planters' Notes 25: 5-6.

Survival of 1-month-old seedlings was inversely related to rate of urea fertilizer application, with all seedlings dying at 600 kg N/ha. Mortality was also related to proximity of urea to the tree seedlings.

296.
Wolters, G.L. 1973. **Southern pine overstories influence herbage quality.** Journal of Range Management 26: 423-426.

Longleaf and slash pine canopies increased protein and phosphorus content and decreased nitrogen-free extract in understory herbage.

297.
Wolters, G.L. 1982. **Longleaf and slash pine decreases herbage production and alters herbage composition.** Journal of Range Management 35(6): 761-763.

Herbage production decreased as early as plantation age 17 years for longleaf pine and plantation age 10 years for slash pine. Understory biomass was correlated positively with seasonal rainfall and negatively with pine basal area. Forbs increased under the forest canopy, but graminoids showed variable responses to increasing crown cover.

298.
Wolters, G.L, A. Martin and H.A. Pearson. 1982. **Forage response to overstory reduction on loblolly-shortleaf pine-hardwood forest range.** Journal of Range Management 35(4): 443-446.

After selective cutting of uneven-aged stands to various densities, herbage and browse production were related to residual pine basal area and site quality. Bluestems were the major forage component on clearings. Browse comprised one-quarter of the forage under stands having high residual pine basal area, but represented considerably lower proportions on clearings.

299.
Wood, B. 1972. **Forest grazing.** Oregon State University, Corvallis. Cooperative Extension Service, Circular No. 798. 11 p.

Range management practices and research in mixed coniferous forestland in Oregon are discussed. Author concludes that cattle, timber, and wildlife are all compatible on forested sites.

300
Young, J.A., D.W. Hedrick and R.F. Keniston. 1967. **Forest cover and logging - herbage and browse production in the mixed coniferous forest of northeastern Oregon.** Journal of Forestry 65: 807-813.

Overstory cover was found to account for more of the variation in herbage yield than either tree basal area or stems per hectare. The highest shrub cover, weight, and current annual growth were all associated with moderate crown closure.

301.
Young, J.A., J.A.B. McArthur and D.W. Hedrick. 1967. **Forage utilization in a mixed-coniferous forest of northeastern Oregon.** Journal of Forestry 65: 391-393.

The degree of livestock utilization was found to be inversely related to overstory crown closure. Management actions that improved use included (1) fencing and water development, (2) the stocking of younger animals, (3) good salting and riding practices, and (4) earlier grazing to obtain better utilization of pinegrass.

302.
Zimmerman, G.T. and L.F. Neuenschwander. 1983. **Fuel load reductions resulting from prescribed burning in grazed and ungrazed Douglas-fir stands.** Journal of Range Management 36: 346-350.

Preburn data indicated higher fuel accumulations in grazed stands due to a predominance of large diameter fuels such as snags, rotten stumps, and insect and disease infected trees. Prescribed burning resulted in a fuel reduction of 60% in the grazed stand and 35% in the ungrazed stand. Authors point out that prolonged grazing had created a dense, overstocked stand with insufficient fine fuels to carry a continuous surface fire, thus limiting the effectiveness of the burn.

3 APPENDIX

3.1 Common and Scientific Names of Plant Species

Alfalfa	*Medicago sativa*
Ash, green	*Fraxinus pennsylvanica*
Aspen, trembling	*Populus tremuloides*
Aster	*Aster* spp.
Balsamroot	*Balsamorhiza sagittata*
Barley, cereal	*Hordeum vulgare*
Bearberry	*Arctostaphylos uva-ursi*
Bentgrass	*Agrostis* spp.
Colonial	*A. tenuis*
Highland	*A. t. oregonensis*
Redtop	*A. alba*
Bitterbrush	*Purshia tridentata*
Bluegrass	*Poa* spp.
Big	*P. ampla*
Bulbous	*P. bulbosa*
Canada	*P. compressa*
Kentucky	*P. pratensis*
Mutton	*P. fendleriana*
Sandberg	*P. sandbergii*
Bluestem	*Andropogon* spp.
Big	*A. gerardii*
Broomsedge	*A. virginicus*
Little	*A. scoparius*
Pinehill	*A. divergens*
Slender	*A. tener*
Bracken fern	*Pteridium aquilinum*
Brome	*Bromus* spp.
Australian	*B. arenarius*
Cheatgrass	*B. tectorum*
Foxtail	*B. rubens*
Mountain	*B. carinatus*
Smooth	*B. inermis*
Soft	*B. mollis*
Buckbrush	*Ceanothus* spp.
Deerbrush	*C. integerrimus*
Burnet, small	*Sanguisorba minor*
Canarygrass	*Phalaris* spp.
Harding grass	*P. aquatica*
Reed	*P. arundinacea*
Carpetgrass	*Axonopus affinis*
Cedar	*Thuja* spp.
Western red	*T. plicata*
Cinquefoil	*Potentilla* spp.
Clover	*Trifolium* spp.
Alsike	*T. hybridum*
Red	*T. pratense*
Rose	*T. hirtum*
Subterranean	*T. subterraneum*
White	*T. repens*
Wooly	*T. microcephalum*

Crownvetch	*Coronilla varia*
Dandelion	*Taraxacum officinale*
Douglas-fir	*Pseudotsuga menziesii*
Dropseed	*Sporobolus* spp.
Black	*S. interruptus*
Prairie	*S. heterolepsis*
Elderberry	*Sambucus* spp.
Fescue	*Festuca* spp.
Alta (tall)	*F. arundinacea*
Arctic	*F. altaica*
Arizona	*F. arizonica*
Chewings	*F. rubra* var. *commutata*
Creeping red	*F. rubra* var. *genuina*
Foxtail	*F. megalura*
Hard	*F. ovina* var. *duriuscula*
Idaho	*F. idahoensis*
Meadow	*F. pratensis*
Red	*F. rubra*
Rough	*F. scabrella*
Sheep	*F. ovina*
Filaree	*Erodium cicutarium*
Fingergrass	*Digitaria eriantha*
Fir	*Abies* spp.
Alpine (subalpine)	*A. lasiocarpa*
Grand	*A. grandis*
White	*A. concolor*
Fireweed	*Epilobium angustifolium*
Fleabane	*Erigeron* spp.
Foxtail, meadow	*Alopecurus pratensis*
Grama, blue	*Bouteloua gracilis*
Hemlock	*Tsuga* spp.
Mountain	*T. mertensiana*
Western	*T. heterophylla*
Junegrass	*Koeleria cristata*
Juniper	*Juniperus* spp.
Larch	*Larix* spp.
Western (mountain)	*L. occidentalis*
Locust, black	*Robinia pseudoacacia*
Lovegrass, weeping	*Eragrostis curvula*
Lupine	*Lupinus* spp.
Milkvetch	*Astragalus* spp.
Canada	*A. canadensis*
Cicer	*A. cicer*
Timber	*A. miser*
Muhly	*Muhlenbergia* spp.
Mountain	*M. montana*
Spike	*M. wrightii*
Mullein	*Verbascum thapsus*
Needlegrass	*Stipa* spp.
Columbia	*S. occidentalis* var. *nelsonii* (*S. columbiana*)
Green	*S. viridula*
Needle-and-thread	*S. comata*
Richardson's	*S. richardsonii*
Western	*S. occidentalis* var. *occidentalis*

Ninebark	*Physocarpus malvaceus*
Oatgrass	*Danthonia* spp.
Timber	*D. intermedia*
Oatgrass, tall	*Arrhenatherum elatius*
Orchardgrass	*Dactylis glomerata*
Panicum	*Panicum* spp.
Peavine	*Lathyrus* spp.
Creamy	*L. ochroleucus*
Cusick's vetch	*L. nevadensis* ssp. *cusickii*
Flat	*L. sylvestris*
Pine	*Pinus* spp.
Coulter	*P. coulteri*
Jack	*P. banksiana*
Jeffrey	*P. jeffreyi*
Loblolly	*P. taeda*
Lodgepole	*P. contorta*
Longleaf	*P. palustri*
Pinyon	*P. edulis*
Ponderosa	*P. ponderosa*
Radiata	*P. radiata*
Red	*P. resinosa*
Shortleaf	*P. echinata*
Slash	*P. elliottii*
Western white	*P. monticola*
Whitebark	*P. albicaulis*
Poplar, balsam	*Populus balsamifera*
Ragwort, tansy	*Senecio jacobaea*
Redwood	*Sequoia sempervirens*
Reedgrass	*Calamagrostis* spp.
Bluejoint	*C. canadensis*
Marsh	*C. inexpansa* var. *inexpansa*
Pinegrass	*C. rubescens*
Rhododendron	*Rhododendron* spp.
Ricegrass	*Oryzopsis* spp.
Roughleaf	*O. asperifolia*
Smilo	*O. miliacea*
Rose	*Rosa* spp.
Ryegrass	*Lolium* spp.
Annual	*L. temulentum*
Italian	*L. multiflorum*
Perennial	*L. perenne*
Ryegrass, cereal	*Secale cereale*
Sagebrush	*Artemisia* spp.
Sainfoin	*Onobrychis viciaefolia*
Sedge	*Carex* spp.
Elk	*C. geyeri*
Pennsylvania	*C. pennsylvanica*
Serviceberry	*Amelanchier alnifolia*
Snowberry	*Symphoricarpos albus*
Spruce	*Picea* spp.
Black	*P. mariana*
Blue	*P. pungens*
Engelmann	*P. engelmannii*
White	*P. glauca*

Squirreltail, bottlebrush	*Sitanion hystrix*
Strawberry	*Fragaria virginiana*
Sumac	*Rhus* spp.
Sweetclover	*Melilotus* spp.
White	*M. alba*
Yellow	*M. officinalis*
Thistle, bull	*Cirsium vulgare*
Threeawn (wiregrass)	*Aristida* app.
Pineland	*A. stricta*
Timothy	*Phleum pratense*
Trefoil	*Lotus* spp.
Big	*L. uliginosus*
Birdsfoot	*L. corniculatus*
Velvet grass	*Holcus lanatus*
Vetch	*Vicia* spp.
American	*V. americana*
Hairy	*V. villosa*
Lana	*V. dasycarpa*
Perennial	*V. tenuifolia*
Wheatgrass	*Agropyron* spp.
Bluebunch (beardless)	*A. spicatum*
Bluestem	*A. smithii*
Crested	*A. cristatum*
Intermediate	*A. intermedium*
Pubescent	*A. trichophorum*
Siberian	*A. sibericum*
Slender	*A. trachycaulum*
Streambank	*A. riparium*
Tall	*A. elongatum*
Wildrye	*Elymus* spp.
Blue	*E. glaucus*
Fuzzyspike	*E. innovatus*
Russian	*E. junceus*
Willow	*Salix* spp.
Woolyweed	*Hieracium scouleri*
Yarrow	*Achillea millefolium*

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